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Paper Title	A Comparison of Drug Use by Fatally Injured Drivers and Drivers at Risk
Author/s	Douglas J. Beirness, Erin E. Beasley, Paul Boase
Year Published	2013
Keywords	road safety, Drug Use, Fatally Injured Drivers, road crashes, Cannabis, Canada

Characteristics of People who Report Both Driving after Drinking and Driving after Cannabis Use

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Abstract

Background: After alcohol, cannabis is the recreational drug most often found among dead or injured drivers. While the effects of alcohol on driving risks are well-described, the effects of cannabis on driving risks are less well understood. We have observed, in survey data, that the chances of past year collisions among drivers who report driving after drinking alcohol (DUIA) are significantly increased, and similarly that the chances of past year collisions among drivers who report driving after cannabis use (DUIC) are also significantly increased. Recently, we examined drivers who reported both DUIA and DUIC (DUIC+A) and found that the past-year collision risk in this group, at 30.5%, was 2-4 times that seen among drivers who reported either behaviour by itself (Sayer et al., in preparation).

Aims: This DUIA+C group may be an important risk group, and the purpose of this study was to explore factors that might distinguish this group from other drivers.

Methods: Data were derived from the CAMH Monitor, an ongoing population survey of Ontario adults (18 years and older). Data from 2002 to 2010 were merged for this study (N=16,054). We compare the demographic, psychosocial, substance use and driving characteristics of four groups of drivers: DUIA, DUIC, DUIA+C, and those who reported no driving after drinking or cannabis use.

Results: The proportion of the population in the DUIA+C group is relatively small, at about 0.9%. Preliminary analyses reveal important differences by age group, with younger drivers being significantly more likely to report DUIA, DUIC and DUIA+C. Drivers who reported any DUIC were also more likely to report DUIA+C than drivers who reported any DUIA.

Discussion and conclusions: Our analyses provide further confirmation that individuals who fall in this DUIA+C group are an important group from road safety perspectives. Further analyses will consider the potential impact of frequency of substance use, substance related problems, and indicators of mental health problems on the likelihood of an individual being in the DUIA+C group.

Introduction

Alcohol and cannabis are two of the most commonly used psychoactive substances (Ialomiteanu, Adlaf, Hamilton, & Mann, 2012). The hazards of driving after drinking have long been known. Alcohol impairs the behavioural and cognitive skills needed for safe driving, and as Blood Alcohol Content increases, the risk of collision involvement increases exponentially (e.g., Borkenstein, Crowther, Shumate, Ziel, & Zylman, 1974). Over the past several decades, many programs and policies have been directed towards preventing driving after drinking and the resulting collisions, injuries and deaths, with important success (e.g., Wickens, Butters, Flam-Zalcman, Stoduto, & Mann, 2013).

Much less is known about the effects of cannabis on driving. For many years, it has been recognized that cannabis does affect psychomotor and cognitive skills in the laboratory, but the impact of cannabis on collision risk has been much less clear. Early epidemiological studies seemed to suggest that driving under the influence of cannabis (DUIC) had little or no effect on collision risk (Bates & Blakely, 1999). However, these findings may have been due in part to methodological difficulties in conducting this research, and more recent studies are providing stronger evidence that DUIC is associated with significant increases in collision risk (e.g., Mann, Stoduto, Ialomiteanu, Asbridge, Smart, & Wickens, 2010;Asbridge, Hayden, & Cartwright, 2012).

Research on DUIC has noted that drivers who report DUIC often report DUIA as well (e.g., Walsh and Mann, 1999; Fischer, Rodopoulos, Rehm, & Ivsins, 2006). A small number of laboratory and epidemiological studies have suggested that the combination of alcohol and cannabis could by itself could result in effects that are larger than the effects of either drug individually (e.g., Biecheler, Peytavin, the SAM Group, Facy, & Martineau, 2008). However, there is little that is currently known about the combined effects of cannabis and alcohol on driving performance or collision risk. As well, while it is known that some drivers report both DUIA and DUIC (hereafter referred to as DUIA+C), the characteristics of these drivers and the collision risks they experienced are not well understood.

Recently, we examined self-reported collision risks in a sample of drivers who report DUIA+C drawn from a large representative sample of the Ontario adult population (Sayer, Ialomiteanu, Stoduto, Wickens, Mann, Le Foll, & Brands, submitted). The results suggested that those who report DUIA+C may be a particularly important group from a road safety perspective. Self-reported collisions in the past year varied substantially among drivers who report no driving after using substances (6.7% reported a collision in the past year), DUIA only (collision reported by 8.5%), DUIC only (collision reported by 14.0%) and DUIA+C (collision reported by 30.5%). We are not able to determine from these survey data if the drivers who report DUIA+C drive after using both substances on the same occasions, but nevertheless their odds of collision involvement were significantly higher than those in known higher risk groups (DUIA and DUIC).

The purpose of this study was to explore factors that might be related to the much higher collision risk seen in the DUIA+C group. We compared the DUIA+C group to drivers who report DUIA only, DUIC only, and no driving after substance use on demographic factors, substance use factors, and mental health factors.

Methods

Data were derived from the CAMH Monitor (CM), an annual repeated cross-sectional survey of Ontario adults. The CAMH Monitor is an addiction and mental health surveillance survey using an anonymous random-digit-dialing telephone survey of the Ontario population aged 18 and older, administered by the Institute for Social Research, York University. The CAMH Monitor is continuously conducted on quarterly samples and employs a stratified (region) two-stage (telephone number, respondent) list-assisted probability sample design. The following 6 regional strata are used: Toronto, Central East, East, Central West, West, and North. Sample sizes have averaged between 2,005 and 3,039 respondents. Response rates varied between 58% and 51%. The weighted sample is considered representative of the Ontario general adult population. For purposes of the current study, data from 2002 to 2012 were merged. Our analysis is based on a subsample of respondents who reported having a valid driving license at the time of the survey (N=22,106). All survey estimates were weighted, and variance and statistical tests were corrected for the complex sampling design.

Groups and Measures

We constructed four groups for purposes of these analyses: (1) Neither DUIA nor DUIC – participants who reported no driving after drinking alcohol and no driving after cannabis use in the past year; (2) DUIA – participants who reported driving after drinking alcohol only in the past year; (3) DUIC – participants who reported driving after use of cannabis only in the past year; and (4) DUIA+C – participants who reported driving after drinking alcohol and reported driving after cannabis use in the past year.

We included measures of gender and age in these analyses. We also included the following measures of substance use, substance problems, and mental health:

Current cigarette smoker. A current cigarette smoker was defined as someone who: 1) has smoked over 100 cigarettes in his/her lifetime, 2) is a daily or occasional smoker, and 3) has smoked in the past 30 days (yes=1).

Weekly binge drinking. Weekly binge drinking was defined as drinking five or more drinks on a single occasion at least once a week during the past 12 months (yes=1).

AUDIT (8+). Hazardous or harmful drinking was measured with the Alcohol Use Disorders Identification Test (AUDIT), a 10-item instrument designed to detect hazardous or harmful drinking at the less severe end of the spectrum. The percentage reported here is based on a score of 8 or more out of 40, which represents an established high-risk pattern of drinking that increases the likelihood of future medical and physical problems, or indicates harmful consequences of use already experienced. The reference period for the AUDIT is the past 12 months before the survey.

Cannabis use. We defined cannabis use as (1) reported using cannabis monthly or more often in the past 12 months; (2) reported using cannabis less than monthly in the past 12months; (3) never used in the past 12 months

ASSIST (4+). Cannabis use problems were measured with the Cannabis Involvement Score on the ASSIST screener, which consists of 6 items assessing cannabis consumption and past-3-month cannabis-related problems. The percentage reported here is based on a score of 4 or more out of 39.

GHQ (3+). Elevated psychological distress was measured with the 12-item version of the General Health Questionnaire (GHQ), a screening instrument used to assess current mental health problems. The items assess the recent frequency of experiencing 12 symptoms (e.g., stress, depression, problem making decisions). Elevated psychological distress is defined as experiencing 3 or more of the 12 symptoms.

Poor mental health. This measure is defined as responses of "fair" or "poor" to the question, "In general, would you say your overall mental health is excellent, very good, good, fair or poor?"

More information on the CAMH Monitor survey, these measures and others included can be found in Ialomiteanu, Adlaf, Hamilton and Mann (2012).

Results

The differences among groups were explored with χ^2 analyses. All analyses are based on the weighted sample size, using STATA software. The findings are summarized in Table 1.

Table 1. Substance use and mental health and demographic and driving characteristics reported by Ontario licensed drivers, aged 18+, CAMH Monitor, 2002-2012

	Total drivers	**No driving after cannabis/ alcohol use**	**Driving after alcohol use only (DUIA)**	**Driving after cannabis use only (DUIC)**	**Driving after cannabis use and driving after alcohol use (DUIA+DUIC)**
Total N	**22106**	**20524**	**1190**	**242**	**150**
	%	%	%	%	%
Gender				***	
Men	50.1	47.5	80.9	74.7	83.1
Women	49.9	52.5	19.1	25.3	16.9
Age				***	
18-34	27.7	26.3	34.5	64.6	66.3
35-54	42.6	42.9	42.6	30.3	28.3
55+	29.8	30.8	22.9	5.1	5.4
Current smoking				***	
Yes	19.8	18.3	27.6	58.6	58.6
No	80.2	81.7	72.4	41.4	41.4
Cannabis Use				***	
Monthly+	6.1	4.0	7.2	89.6	87.9
Less than monthly	6.6	5.8	17.9	10.4	12.1
Never past 12m	87.3	90.2	74.9	-	-

ASSIST (4+)				***	
Yes	5.2	3.3	6.2	87.0	84.6
No	94.8	96.7	93.8	13.0	15.4
Alcohol use - weekly binge drinking				***	
Yes	9.5	7.2	35.5	28.7	57.7
No	90.5	92.8	64.5	71.3	42.3
AUDIT (8+)				***	
Yes	13.3	10.1	47.2	44.6	82.4
No	86.7	89.9	52.8	55.4	17.6
GHQ (3+)				***	
Yes	12.7	12.2	15.5	21.4	27.3
No	87.3	87.8	84.5	78.6	72.7
Self-Rated Mental Health				**	
Fair/Poor	5.2	4.9	6.8	9.6	12.1
Good	94.8	95.1	93.2	90.4	87.9

Note: Significant difference - design based chi-square: **p<.01; **p<.001

Substantial differences among the four groups are observed, and differences are statistically significant for all measures. Drivers in the three groups that report substance use and driving are much more likely to be male than drivers who do not report driving after substance use. The three substance use and driving groups are also more likely to be younger. The two youngest groups are the DUIC and DUIA+ C groups, while the DUIA group includes more middle-aged drivers. Similarly, the DUIC and DUIA+C groups are much more likely to be tobacco smokers than the other two groups. The DUIC and DUIC+A groups are also much more likely to be cannabis users than the other two groups. There also appears to be a strong association of cannabis problems with driving after using cannabis. Over 80% of both the DUIC and DUIA+C groups scored in the problem range on the ASSIST, compared to 7.2% among DUIA drivers and 3.3% among those who reported no driving after substance use. Interestingly, alcohol use and problem measures appeared to differentiate the DUIC and DUIA+C groups; 57.7% of the latter group compared to 28.7% of the former reported weekly binge drinking, and 82.4% of the latter group compared to 44.6% of the former fell into the harmful/hazardous drinking range on the AUDIT. It is also interesting to see that the DUIA+C group are also more likely to report binge drinking and hazardous/harmful alcohol consumption than the DUIA group. Finally, similar patterns were also observed on mental health measures, although differences were not so pronounced. The three groups reporting substance use and driving show more evidence of mental health problems than those who did not report any driving after substance use. The DUIA+C group demonstrated the highest levels of psychological distress as measured by the GHQ12, and were most likely to report fair or poor mental health.

Discussion and conclusions

While these exploratory findings are interesting, it is important to keep in mind the limitations of this research. The findings are based on self-reports and while the response rate of the Monitor is considered good, nevertheless nonresponse and other forms of bias may be affecting these results. As well, we cannot determine whether or not those who reported DUIA+C combined alcohol combined use of alcohol and cannabis on individual driving occasions.

Nevertheless, the results are of substantial interest and provide additional confirmation that individuals who report both driving after drinking and driving after using cannabis may be an important group from a road safety perspective. The high rates of collisions reported by the DUIA+C group (Sayer et al, submitted) may be influenced by several factors known to affect driving safely. This group consists of predominantly young male drivers who are known to have higher collision rates and to show higher levels of risk taking and related characteristics that enhance collision risk (e.g., Mann, Stoduto, Vingilis, Asbridge, Wickens, Ialomiteanu, Sharpley, & Smart, 2010). Substance use and problem measures also appeared to characterize the DUIA+C group. Interestingly, while their rates of cannabis use and cannabis problems (as measures by the ASSIST) were similar to those seem among the DUIC group, their rates of heavy drinking and drinking problems appeared much higher than those seen among the DUIA group. Heavy substance use and substance problems are known to be associated with increased collision risk and collision-related mortality rates (e.g., Mann et al, 2010; Callaghan, Gatley, Veldhuizen, Lev-Ran, Mann, & Asbridge, 2013). As well, since these drivers already appear to be combining heavy alcohol and cannabis use, they may be more likely to use other collision-enhancing substances as well. Finally, the DUIA+C group was also characterized by highest levels of mental health concerns, which are increasingly being linked to elevated collision risk (Wickens, Mann, Stoduto, Ialomiteanu, & Rehm, 2013). The remarkably high rates of collisions seen in the DUIA+C group may thus be related to many factors, and more research to identify those most salient to increasing their collision risk is needed.

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Influencing Behavioral Intentions toward Texting and Driving: Lessons Learned from a Multifaceted Prevention Campaign

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Abstract

Context
Impaired and distracted driving among youth is a serious national issue which results in numerous fatalities and injuries each year. According to the Centers for Disease Control, car crashes are the leading cause of death among people ages 16 to 21. On average, eight young people die every day due to car crashes. Contributing to the carnage is the growing problem of distracted driving. Drivers who frequently engage in inattention-related activities are more likely to be involved in inattention-related crashes and near-crashes. Drivers who are engaging in moderate to complex non-driving tasks are between 1.6 and 5.5 times as likely to be involved in a crash or near-crash (Klauer, S.G. et al., The Impact of Driver Inattention On Near-Crash/Crash Risk, April 2006)

Objectives
This project implements a distracted and impaired driving prevention campaign targeted at teenagers (aged 16 to 19) in two U.S. rural community high schools. Known as M.E.T.H.O.D. (Mind, Eyes, Two Hands On Driving), this teen-led campaign was designed by U.S. based company, Innocorp, ltd., to reduce behavioral intentions toward impaired and distracted driving by addressing their multifaceted determinants. These include self-efficacy, response efficacy, threat and coping appraisal, barriers and benefits to change, subjective norms and public commitment toward change. The research-based campaign activities were designed to be hands-on, fun, and engaging for youth. We analysed survey data on 100 students to illuminate behavioral intentions toward impaired and distracted driving.

Key Outcomes
Using a youth-led multifaceted campaign, incorporating a definitive call-to-action, and involving school and community leaders in the initiative proved crucial for program success. The survey analysis indicates that students' disproportionate belief that they are effective drivers even when distracted was a key predictor of distracted driving among the students we surveyed.

Discussion and conclusions
A call to action must be easy to understand, easy to commit to doing, relevant to addressing the problem of distraction, and relevant to the individuals committing to the action. Programs may need to tailor their interventions to their targeted populations and forms of distracted driving.

Introduction

In 2011, 3,331 people were killed in crashes involving a distracted driver, compared to 3,267 in 2010. An additional, 387,000 people were injured in motor vehicle crashes involving a distracted driver, compared to 416,000 injured in 2010. (Key Facts and Statistics, Retrieved April 20, 2013 from http://www.distraction.gov/content/get-the-facts/facts-and-statistics.html). The problem of distracted driving is compounded as new communications technology, GPS, mobile phones, and other devices that call for our attention are introduced into the driving environment. In 2008, an estimated 28% of all crashes, or 1.6 million, on U.S. highways are caused by drivers using cell phones (National Safety Council White Paper, 2010). In fact, using a cell phone while driving increases one's crash risk by a factor of 23 (Virginia Tech Transportation Institute, Retrieved April 22 from http://www.vtti.vt.edu/featured/0413-distracted-driving.html).

Federal observational data from the NHTSA 2010 study shows that about 5 percent of drivers in 2009 were talking on hand-held phones at any moment during the day. This equates to about 672,000 passenger vehicles on the road at any moment during the day were driven by people talking on hand-held phones.

In this age of limited resources and shrinking budgets, it is imperative that social scientists continue to develop theories and approaches for message construction and prevention campaigns to ensure these are both effective and efficient (Fishbein, M. et al., 2006). To reduce crash risk and the injuries and fatalities that result, it is important to identify interventions that encourage drivers to turn off their cell phones while driving. Research is needed to identify methods for influencing the behavioral intentions of drivers who intend to use a cell phone while driving. This paper addresses this need by exploring teens' behavioral intentions toward using cell phones while driving through the implementation of a distracted driving prevention campaign. We present findings on the behavioral intentions of distracted driving as well as lessons learned from the implementation of the campaign in two high schools in a suburban U.S. community.

Behavioral Intentions toward Distracted Driving

Distracted driving involves the diversion of a driver's attention away from activities critical for safe driving and toward a competing non-driving task (Regan et al., 2009). It is not unusual to see drivers simultaneously engaging in distracting activities while driving. This may include reading a book or a map, interacting with the GPS, eating, putting on makeup, or talking or texting on a cell phone while driving. Research suggests two key mechanisms through which teens' develop behavioral intentions to drive while distracted: sensation-seeking and perceived self-efficacy.

Sensation-Seeking

Sensation-seeking is the "seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financials risks for the sake of such experience" (Zuckerman, 1978, p. 139-149). Sensation-seeking tendency has been positively linked to participation in a number of risky behaviors, such as smoking, heavy drinking, drug abuse, and driving under the influence of alcohol (Curran, M.F. et al., 2010, The Association of Sensation Seeking and Impulsivity to Driving while under the Influence of Alcohol). Therefore, high sensation-seeking teens may have strong behavioral intentions to drive distracted regardless of whether they believe they are equipped to do it well.

Perceived Self-Efficacy

Perceived self-efficacy refers to confidence in one's ability to complete a given task. In many domains, people's sense of self-efficacy is optimistically biased. That is, they tend to overestimate the probability of positive events and underestimate the probability of negative ones (Sharot, 2011). A consistent finding in cognitive science is that attention has a limited capacity (Fougnie et al., 2006). Nowhere are these limitations more evident than in situations in which people attempt to multitask, that is, perform two or more attention-demanding tasks concurrently. Ironically, a recent study looking at multitasking ability found that individuals who report multitasking more frequently (as it relates to multimedia consumption from multiple sources) multitask *less* well than those who are multitasking less frequent (Ophir et al., 2009).

With regard to driving, people tend to mistakenly believe they can simultaneously engage in non-driving related tasks, like texting on a cell phone, without affecting their driving performance. In other words, drivers have a blind spot for loss of attention due to cell phone use, and thus they are unaware of their own driving impairments (Strayer & Drews, 2007). Rather, many people insist that they are not impaired when they use a cell phone while driving, despite readily admitting that they have seen others who drive erratically when they use their cell phones (Watson et al., 2003). This optimistic bias may give people a false sense of control over driving while distracted.

In a modern context in which teens are increasingly accustomed to multitasking, they may be particularly at risk for optimistic bias in their perceptions of their ability to safely drive while using a cell phone. Teens are especially likely to underestimate their susceptibility to harm or the severity of potential negative consequences of some behaviour, and this belief increases the likelihood that they will engage in the behavior (Sharot, 2011). Greater perceived self-efficacy to multitask while driving (or in general) may increase the likelihood that teens will use their phones while driving.

Approach

The aim of this paper is two-fold: (1) to ascertain the degree to which perceived self-efficacy and sensation-seeking are associated with behavioral intention to drive while distracted; (2) to report lessons learned from implementing an intervention designed to address behavioral intentions toward distracted driving among teens. We implemented a distracted and impaired driving prevention campaign targeted at teenagers (aged 16 to 19) in two U.S. rural community high schools. Known as M.E.T.H.O.D. (Mind, Eyes, Two Hands On Driving), this teen-led campaign was designed by U.S. based company, Innocorp, ltd., to reduce behavioral intentions toward impaired and distracted driving by addressing multifaceted potential determinants. These include self-efficacy, response efficacy, threat and coping appraisal, barriers and benefits to change, subjective norms and public commitment toward change.

The M.E.T.H.O.D. campaign is collaboratively implemented by students, school resource officers, and administrators. Teen leaders work with school and community leaders to engage peers in activities that promote responsible driving. The research-based campaign activities are designed to be hands-on, fun, and engaging for youth. These include educational activities that provide evidence-based and locally-specific information to the community, and experiential activities that demonstrate our susceptibility to the serious consequences of driving while distracted. This non-authoritarian approach is designed to allow people to come to their own, well-informed conclusions about adopting responsible driving behaviors. The campaign culminates in a concrete call-to-action, a teen-led initiative asking peers and community members to commit to specific responsible driving behaviors.

A key component of the program is the “multitasking demonstration,” which is designed to create cognitive dissonance between people’s optimistically biased beliefs about their self-efficacy and a direct experience demonstrating their actual ability to multitask. In the multitasking demonstration, students are asked to do two tasks: counting backward from 100 as far as they can without missing numbers, and correctly matching as many differently colored shapes as possible without making mistakes. Students first complete these tasks separately for 30 seconds each. Students are then asked to guess how well they will do on each task if they do them simultaneously, after which they complete the tasks simultaneously for 30 seconds. At the end of the demonstration, students are faced with concrete dissonance between their perceptions and direct evidence of their ability to multitask.

As part of the campaign, we also collected survey data on 100 students to illuminate their behavioral intentions toward distracted driving, which was measured using the prompt:

> You are driving in your vehicle down a road in town. There are some shops and parked cars. It is about 2 o'clock on a fine dry afternoon. You hear your cell phone ring in the seat beside you.

Students were then asked how likely they would be to use their cell phone in the hypothetical situation and, if they used it, how likely different consequences would be (e.g., "I would find it difficult to pay attention to the road"). In addition, students responded to 10 items designed to measure their sensation-seeking tendency by indicating their level of agreement with statements such as, "I enjoy the feeling of fast driving or riding in a speeding car."

Evidence about Behavioral Intention to Drive while Distracted

As shown in figure 1, high school students in the target community have high behavioral intentions to use a cell phone while driving, where the majority of students reported they would be likely or very likely to answer their cell phone (67%) or to check the phone (84%). Conversely, less than 10% reported these behaviours were "not at all likely." Figures 2 and 3 demonstrate that students disproportionately believe that they are effective drivers even when distracted or using a cell phone and that they are less susceptible than others to distraction. Students varied more widely in their sensation-seeking, with a mean of 2.5 (*Std. Dev.*=0.53) on the 10-item scale ranging from 1 (not at all sensation-seeking) to 4 (very much).

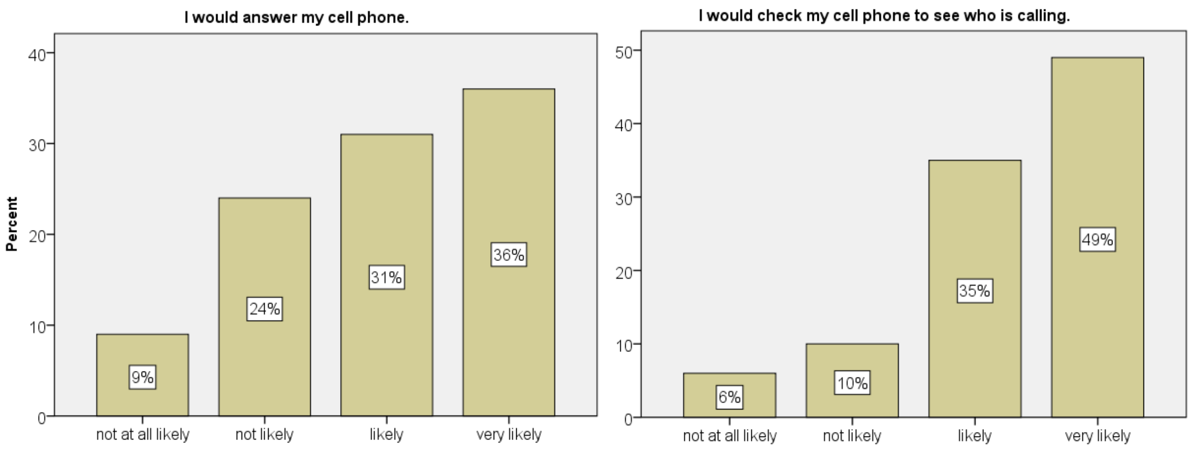

Fig. 1 Distribution of Behavioral Intention to Use Cell Phone while Driving

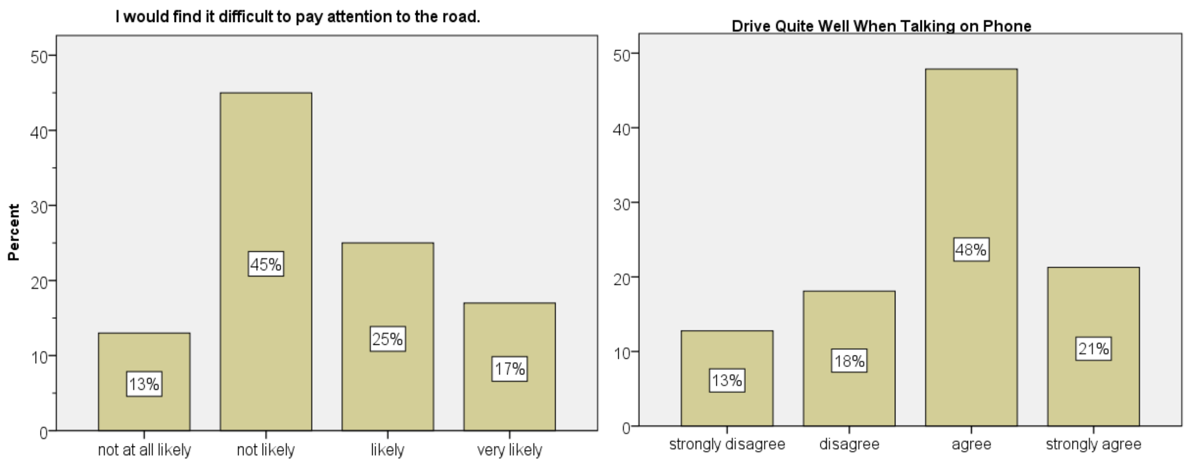

Fig. 2 Distribution of Perceived Self-Efficacy when Using Cell Phone while Driving

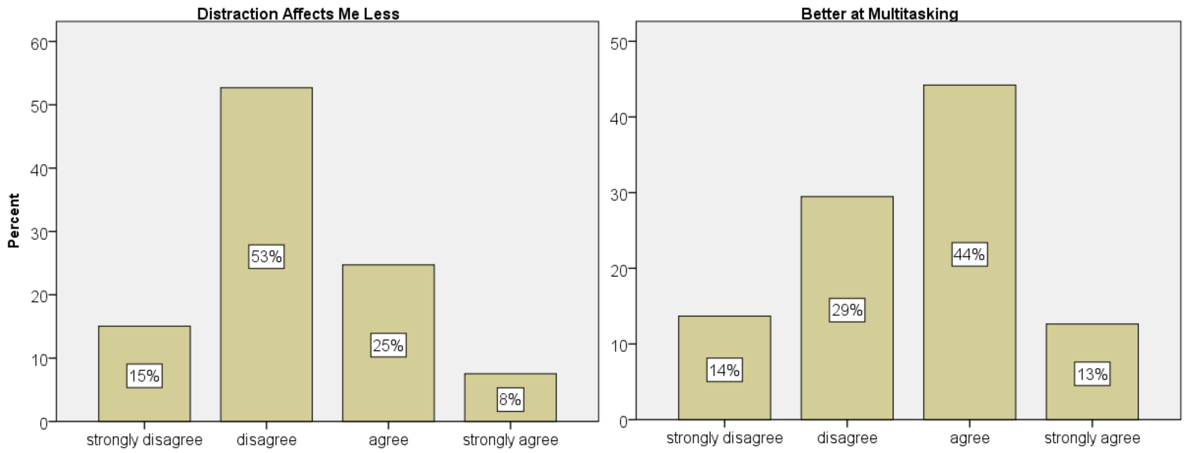

Fig. 3 Distribution of Perceived Self-Efficacy toward General Multitasking

Correlational analyses indicated that the behavioral intention to use a cell phone while driving (i.e., would answer phone, would check phone, would not let phone go to voicemail) is positively associated with perceived self-efficacy but not sensation-seeking. The 10 survey measures on sensation-seeking were not significantly related to student reports about the likelihood that they would use a cell phone in the hypothetical scenario. Measures of self-efficacy (i.e., better than others at multitasking, less affected than others by distraction, have effective ways to drive and use phone, drive quite well using phone) were positively and significantly associated with students' behavioral intentions to drive while distracted, regardless of whether the items were treated separately or combined into composite scales (Cronbach's $\alpha > .80$). The association was consistently positive, statistically significant ($p < 0.01$), and moderately sized ($0.314 \leq$ Pearson's $r \leq 0.668$). The correlation coefficient for the association between the scaled items was 0.640 ($p < 0.01$).

Lessons Learned from Implementation of M.E.T.H.O.D. Campaign

Three aspects of the program stood out as particularly crucial for the success of the campaign: use of a youth-led multifaceted campaign, incorporating a definitive call-to-action, and involving school and community leaders. A youth-led and multifaceted campaign was important because research suggests youth have more influence among their peers in promoting positive driving behaviours. It was also important that the call-to-action was easy to understand, easy to commit to doing, relevant to addressing the problem, and relevant to the individuals committing to the action (Fishbein, et al., 2006).

Conclusion

The goal of this study was to identify variables that impact teens' behavioral intentions to text and drive, and to ascertain lessons learned from a distracted driving prevention campaign that was successfully implemented in two U.S. rural community high schools. As the National Transportation Safety Board noted in their recent call for a ban on all cell phones in cars, laws alone will not solve the problem of distracted driving. It will take aggressive (and effective) educational campaigns and enforcement.

Our survey analysis suggests that optimistic bias about self-efficacy to drive while using a phone indeed is a strong predictor of students' behavioral intentions to drive distracted. This suggests that our campaign, which provided information and experiential activities, created dissonance between teens' naïve beliefs about their ability to multitask and their actual ability to do so. The identification of behavioral intentions improves our ability to intervene on them in ways that deter the use of a cell phone while driving.

Future research should explore whether the behavioral intentions are the same for other forms of distracted driving (e.g., due to eating, listening to music, talking in the car) or other populations (e.g., the elderly, the general population). Programs seeking to reduce crashes and injuries caused by distracted driving may need to tailor their interventions to their targeted populations and forms of distraction.

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The "Cheese Ball" Killer – The Car as a Murder Weapon

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New South Wales Police Force

"Before you embark on a journey of revenge, dig two graves."
~ Confusius, China's most famous Teacher, Philosopher and Political theorist (551 – 479 BC)

Background
The incidence of violent crime in the community is an issue of on-going concern, particularly in cases of murder and manslaughter. The weapons and methods used in the commission of murder in Australia have remained relatively unchanged over the years. The most common types of weapons used in murder (homicide) are generally weapons of opportunity, such as knives or sharp instruments and hands/feet, with a firearm becoming the third most common weapon for male victims/perpetrators. Other methods included blunt instruments, fire, hanging or strangulation. The use of an automobile as a murder weapon is quite rare.

Aims
To present a case where an automobile was used as a murder weapon. This case was unusual as the series of events which unfolded were captured on a closed-circuit television (CCTV) camera.

Methods
This case was drawn from our day to day forensic casework. The CCTV footage derived from the crime scene was converted to real time and 'burnt' to a DVD. Blood samples were taken from both the victim (at post-mortem) and the female perpetrator of the crime when she was taken into Police custody. These blood samples were then analysed by a NATA accredited laboratory.

Results
Both the victim and the perpetrator presented high range readings for alcohol. However, the perpetrator also had other drugs in her system namely, cannabis, diazepam and 'ecstasy' (3,4-methylenedioxymethylamphetamine). Also, the CCTV footage proved to be useful evidence as it clearly showed intent by the female perpetrator.

Discussion and conclusions
The victim, an intoxicated young man in a boisterous gesture, threw some cheese balls into the young woman's motor vehicle. In a fit of rage, the perpetrator whilst intoxicated with cannabis, 'ecstasy' and alcohol, sought the ultimate revenge and used her motor vehicle to end the young man's life.

Introduction/background

The victim, Eli, a young man of 21 years was drinking and socialising with friends at home on the night of the 6 June, 2008. Around 2.30 am the next morning they attended a tavern where they continued drinking. They were walking home just after 4 am when they went into a store where his older brother purchased a packet of cheese and bacon balls.

On that same night the female perpetrator, Sarah, was drinking with friends. She consumed a bottle of wine, smoked two cones of cannabis and took four 5 mg tablets of Valium (her regular dose was only 2 tablets) at home. Around 11 pm she attended a bar where she took an "ecstasy" tablet washed down with a glass of wine. She then returned home with friends and consumed another bottle of wine before getting in her car with a friend around 4 am allegedly intending to go to a shop to buy cigarettes.

Around 4.20 am Sarah was driving down a street when she encountered the victim and his friends. The victim in a playful mood, threw some cheese balls into the air and shouted "happy honeymoon!" and the couple in the car. Some of the chesses balls landed onto the car. Sarah got out and appeared "very aggressive" and she tried to kick and punch one of the males in the group who cried out "Settle down, it's just chips. What are you doing?" The group thinking that was the end of the matter walked down an alleyway away from the vehicle.

Sarah got back in her car, sat in the seat and said to her passenger "I have had enough of these guys" and then she accelerated the vehicle into the alley. She drove towards the group hitting the victim Eli on the legs and he tried to get out of the way. He limped away. One of the males in the group yelled "Run, let's get out of here. This is crazy" and they hid behind some industrial skip bins. Sarah then reversed, turned off the car's lights and waited. After a short time the victim and his friends, thinking the danger was over, emerged and were greeted by the headlights on high beam and the car lunging forward at them. The car drove onto the kerb colliding with one of the males who fortunately only suffered minor injuries but the victim was not so lucky and he was knocked down and pinned under the car as it then careered down some stairs at the entrance to a gym. Sarah's friend left the vehicle and ran off however she remained at the scene. Police and ambulance officers attending did not realise for some time the victim was still under the car.

Blood and Breath Results

Sarah was breath tested at the scene on a screening device indicated a positive result (0.196 g/100ml). She underwent a breath analysis at a later time indicating the equivalent of a blood alcohol concentration of 0.145 g/100ml of blood. She was later taken to a hospital where a blood sample was also taken at 6.30 am. The results are indicated in Table 1.

Table 1: Blood results for the driver.

drug detected	***concentration***
Alcohol	***0.140 g/100ml***
3,4 methylenedioxymethylamphetamine	***0.07 mg/L***
delta-9-tetrahydrocannabinol	***0.005 mg/L***
delta-9-THC acid	***0.023 mg/L***
diazepam	***0.22 mg/L***

nordiazepam	***0.07 mg/L***
temazepam	***<0.01 mg/L***
venlafaxine	***<0.1 mg/L***

The perpetrator's BAC was estimated by Dr Allender to have been most likely to be 0.171 g/100ml at the time of the incident. An expert called by the defence estimated her BAC at the time of the incident to have been most likely 0.176 g/100ml.

The victim, Eli, suffered multiple injuries including severe head injuries. The victim's post mortem sample results are indicated in Table 2.

Table 2 : Post mortem sample results for the victim

sample type	drug and concentration	
blood (femoral, preserved)	alcohol	0.186 g/100ml
urine	alcohol	0.242 g/100ml
vitreous humour (preserved)	alcohol	0.219 g/100ml

No other drugs were detected in the victim.

Discussion and Conclusions

The perpetrator, Sarah, underwent an electronically recorded video/audio interview. She stated that she consumed a bottle of wine at home, a glass of wine at a bar and then another bottle of wine at home. She also stated she took an ecstasy tablet, smoked some cannabis and took some Valium (diazepam). She stated she often binge drinks and can get "emotional and fight" after consuming alcohol. She stated that when she and her friend went to the shop to get cigarettes the group of males near the shop were fighting and she tried to drive away in panic. She also stated her passenger had grabbed the steering wheel causing her vehicle to collide with one of the males on the road.

Sarah seemed unable to provide a satisfactory explanation as to how the vehicle ended up in the street where the incident took place.

The CCTV footage became a major factor in the trial. The defence alleged Sarah was highly intoxicated , she had difficulty reversing and accelerated in a state of panic and the passenger pulled the steering wheel. However the CCTV footage showed the vehicle "stalking" the group of males, including the victim, then driving towards the group, up onto the footpath, hitting the victim , reversing and then driving onto the footpath again towards the victim.

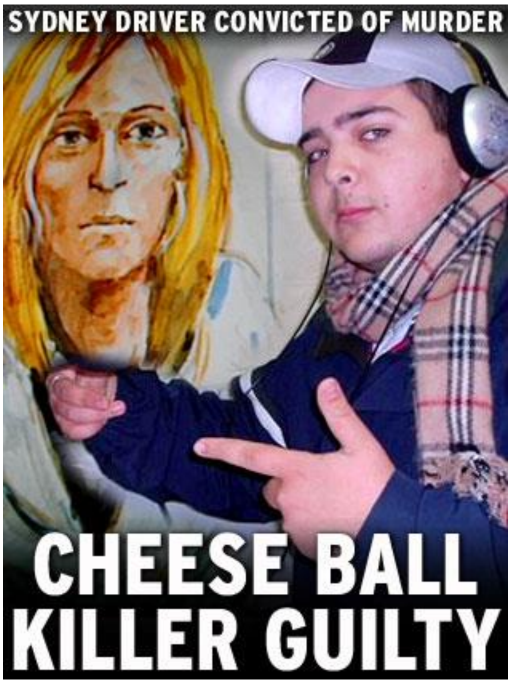
The jury, by majority verdict, found the driver Sarah guilty of murder and she was sentenced to a maximum of 25 years gaol with a non-parole of 20 years.

The Judge in summing up stated:

"I have no doubt that she waited on the street until the deceased ventured out of hiding"

> *"She was aware that, when affected by alcohol, she acted impulsively, toward things that irritated her… and that it was a senseless act of anger."*
> He continued *"She clearly wanted to teach the young man a lesson." "It was an intention to inflict very serious injury and the risk of death was very high."*

A young life snuffed out in "...a *senseless act of anger."*



This headline appeared in the 'Daily Telegraph'

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Evidence-based drinking and driving policies in Brazil: using evidence to guide policy changes

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Abstract

Context
Although Brazil has made important attempts to change drinking and driving legislation over the past few years, with the aim of strengthening the punishment for drunk drivers, the burden of road traffic accidents in the country remains one of the highest in the world. The most notable example was the new traffic law introduced in 2008, which lowered the blood alcohol concentration (BAC) limit for drivers from 0.06% to 0.02%. This law resulted in significant reductions in traffic accident rates but also revealed the limitations of using research-derived evidence to guide policy changes in developing regions.

Objectives
This paper analyses the current situation regarding drinking and driving policies in Brazil based on the most recent research conducted on this topic. Data obtained from peer-reviewed journals and public discussions since the main enactment implemented in 2008 were reviewed and compared to similar strategies that were demonstrated to be effective in reducing alcohol-related traffic accidents in developed countries.

Outcomes
Lowering the BAC limit for drivers, which is a well-known effective evidence-based policy change, reduced the number of traffic accidents and the frequency of driving under the influence (DUI) of alcohol in Brazil. However, policy makers have ignored relevant features concerning the effectiveness of this type of policy, such as the level of enforcement and the perceived risk of DUI sanctioning. Additionally, the lack of evidence able to support the creation and maintenance of drinking and driving policies is considered a great barrier to enhancing the effectiveness of these policies.

Conclusions
Further investigation into the effects of measures derived from high-income countries to control alcohol-impaired driving should be promoted in developing countries. Moreover, searching for the best way to translate evidence into policy should be a priority in these countries, where policies emerging from research may hold the key to improving the effectiveness of actions aimed at reducing alcohol-related traffic accidents.

Introduction

Currently, eighty per cent of all road traffic fatalities occur in middle-income countries such as Brazil, which, more often than not, have lower levels of motorization than high-income countries (World Health Organization, 2013). This uneven distribution of the burden attributed to traffic accidents between developing and developed countries clearly indicates that the risk of being involved in a traffic accident varies according to the socioeconomic level of the population.

The rapid increase in the number of vehicles, together with the lack of adequate traffic safety policies, are considered the main reasons for the growing health and social burden attributed to road traffic injuries globally (Nantulya & Reich, 2002). For instance, only 7% of the world's population is covered by regulations addressing the main risk factors for traffic accidents (e.g., excessive speed and drunk driving) (World Health Organization, 2013). In this sense, it seems very plausible that enhancing efforts directed towards the implementation of new road safety laws is necessary to control one of the leading causes of death in Latin America, particularly legislation regarding the use of alcohol by drivers, which accounts for 20-50% of traffic accident deaths in the region (Pan American Health Organization, 2007).

However, many questions must still be answered when transposing strategies that have been demonstrated to be effective in reducing alcohol-related traffic accidents from developed countries to developing regions. Over the past few years, Brazil has made notable attempts to change drinking and driving legislation with the main goal of strengthening the punishment for drunk drivers; thus, Brazil serves as a good model for studying the issues involved in using evidence to guide policy changes in social settings where resources for road infrastructure and law enforcement are limited.

Therefore, the objective of the present paper is to present and discuss the main effects of the changes to drinking and driving laws on the reduction of DUI occurrences in Brazil and to identify the best policy approaches for following these enactments. This paper considers the most up-to-date research findings on this topic and the distinct situation involving the control of drinking and driving among Brazilians.

Outcomes

The Brazilian scenario: drinking and driving legislation

Brazil started to enforce its first drink-drive law based on BAC limits in 1998, when a DUI offense was considered a BAC in excess of 0.06% (Federative Republic of Brazil, 1997). At the time, a pre- and post-law comparison study conducted in a city in southern Brazil demonstrated a reduction in the number of car (-20%) and motorcycle (-9%) accident-injured victims after the law was implemented, including a significant decline in the proportion of alcohol breath odour detected among motorcycle riders (Liberatti et al., 2001).

After a period of a relatively constant rate of traffic fatalities in Brazil since the first enactment of this law (approximately 20 deaths per 100,000 inhabitants) (Bacchieri & Barros, 2011), the federal government introduced a new law in 2008 that reduced the BAC limit for drivers from 0.06% to 0.02%, concurrent with a substantial rise in the penalties based on BAC test results. Drivers caught with a BAC between 0.02-0.06% were subject to a fine of approximately US$475 and the temporary suspension of their driver's license, while those with a BAC above 0.06% could face a full suspension of their driver's license and a criminal sanction of up to 36 months of imprisonment (Federative Republic of Brazil, 2008).

Previous studies conducted in Brazil have supported the effectiveness of such enactments, in terms of the reduction of both traffic accidents and the frequency of DUI. These results are in accordance with the findings from the worldwide literature, showing that lowering the BAC limit for drivers is an effective way to diminish alcohol-impaired driving (Mann et al., 2001). In Sao Paulo, the largest city in Brazil, it was estimated that the new traffic law was responsible for a significant reduction in the monthly rates of traffic fatalities (-16%) and injuries (-2.3%) (Andreuccetti et al., 2011), as well as a 45% decrease in the proportion of positive breathalyser tests among randomly stopped drivers (Campos et al., 2013).

Despite the beneficial effect attributed to the new legislation, a driver's right to refuse a BAC test was noted as an important barrier to the application of criminal sanctions against drunk drivers (Andreuccetti et al., 2010), given that the sanctions imposed on the 2008 legislation were dependent on the BAC test findings. As a consequence, a new change in the previous law that allowed police officers to use other evidence (e.g., clinical signs, videos or witnesses' reports) to support a DUI offense - particularly when the driver refused to provide a BAC sample - was approved in December 2012. This law also made it illegal to have any measurable amount of alcohol in the blood and introduced a fine that was twice as high as it had been in 2008 (Federative Republic of Brazil, 2012).

Is the zero tolerance law the best approach?

Although there is strong evidence supporting the beneficial impact of reducing the legal BAC limit to 0.05% or lower (World Health Organization, 2013), the idea that implementing a zero tolerance law will generate a general deterrence effect is still controversial, especially when sanctions and punishment capacities are constrained (Kleiman & Kilmer, 2009).

In fact, there is little support for the argument that countries that have lower BAC limits for drivers also demonstrate smaller proportions of road traffic deaths attributable to alcohol. For example, when the association between BAC limits and alcohol-related traffic deaths was tested among 85 countries for which these data are available, a weak and non-significant correlation was found (Figure 1). Moreover, this association did not vary significantly, even accounting for the countries' income levels, although it is known that the burden of road traffic fatalities is shared disproportionately by low- to middle-income countries (Nantulya & Reich, 2002).

This finding is of great interest for developing countries such as Brazil, where the main goal of the drastic changes in drinking and driving legislation over the past years was to increase the general deterrence effect of these laws and thus augment the perceived risk of DUI sanctioning, which would result in a decrease in the rate of alcohol-related traffic accidents. However, it has been shown that the decrease in the prevalence of drivers who reported driving after binge drinking in Brazil observed right after the 2008 enactment, which increased the severity of sanctions for drivers who consumed any amount of alcohol, was sustained for less than four months after this law was put into practice (Moura et al., 2009).

Contributing factors to the effectiveness of DUI laws

Another interesting finding from the recent research conducted in Brazil regarding the effectiveness of reducing the driver BAC limit was that a stronger impact of the new traffic law was observed for traffic fatalities than for traffic injuries and in regions with greater DUI enforcement (Andreuccetti et al., 2011; Neves Nunes & Costa Nascimento, 2012). Thus, it seems that both the severity of traffic accidents, which might be related to a different effect of this type of law on drunk-driving populations with diverse drinking patterns (Mann et al., 2003), and the level of police enforcement are relevant to consider when analysing the differential deterrence effect of drinking-driving legislations.

In addition, road traffic accidents influenced by alcohol suffer seasonal variation and depend on a series of social behaviours and mass media strategies, including but not limited to drinking frequency, motor vehicle utilization rates and media coverage (Mann et al., 2001; Moura et al., 2009; Pechansky et al., 2012). Therefore, the full amount of data on the variation of these characteristics must be evaluated before directing efforts towards specific policies that address only one contributing factor, which usually do not consider the whole picture of the drinking and driving behaviour in each locality.

Research gaps and future directions

Although research on drinking and driving in Brazil has advanced over the last decade, one of the major gaps that hampers the establishment of an evidence-based prevention and enforcement law against drunk drivers is the lack of a systematic collection of data on road traffic injuries and fatalities (Pechansky & Chandran, 2012), including information on BAC levels from drivers and victims, at both the national and state levels.

It also should be noted that any public health policy trying to achieve successful outcomes should not ignore the socio-cultural barriers that are specific to each region. Because the public in the Brazilian scenario seems to favour a more severe punishment for convicted drunk drivers rather than a stricter DUI law for everyone (Andreuccetti et al., 2012), the desired general deterrence effect expected of such laws may rely on a higher capacity of putting DUI sanctions into effect and of improving resources for police enforcement, instead of constantly changing laws that are not based on the most informed evidence of the effectiveness of reducing alcohol-related traffic accidents.

Conclusions

Policy makers and traffic safety stakeholders should be aware of the limitations involved in the implementation of zero-tolerance drinking and driving laws, especially in low- to middle-income countries where resources for the enforcement of these laws are scant. In view of the findings from the present review of the effectiveness of the strategies used in Brazil aimed at reducing alcohol-impaired driving, a full assessment of the infrastructure and supporting measures of such laws should be offered before implementing drastic changes in legislation. Furthermore, the combination of different strategies that account for the various factors contributing to the effectiveness of DUI laws, together with the involvement of several government sectors and the support of the public, sounds far more reasonable than appealing to the general deterrence effect of stricter DUI laws.

In conclusion, the idea of implementing traffic safety models from developed countries aimed at reducing alcohol-related traffic accidents should be promoted in developing regions. Nevertheless, the promotion of this idea should be followed by a simultaneous and rigorous gathering of local evidence capable of guiding the creation and maintenance of effective policies against drunk driving.

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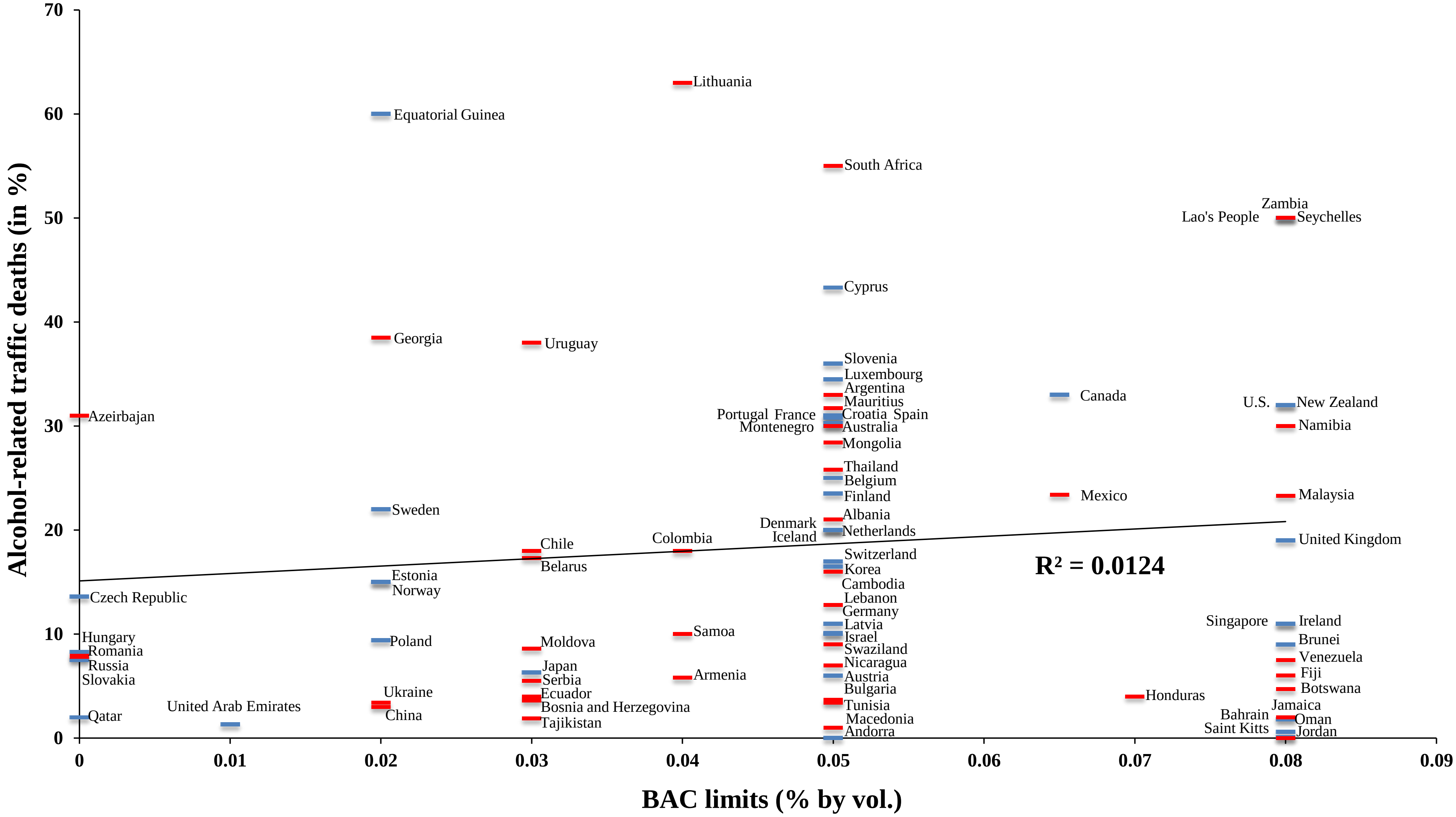

Figure 1. Correlation between blood alcohol concentration (BAC) limits and the proportion of road traffic fatalities attributable to alcohol use in 85 different countries. High-income countries are marked in blue, while low- to middle-income countries are in red. Spearman's correlation coefficient (r_s=0.11; P=0.30). *Source: World Health Organization (2013). Global status report on road safety 2013: supporting a decade of action. Geneva, Switzerland.

Developments in Canadian community-based impaired driving initiatives: MADD Canada's "Campaign 911"

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Abstract

Context
Despite numerous legislative amendments, countless awareness programs and similar initiatives, impairment-related crashes remain the leading criminal cause of death in Canada. The progress made from the early 1980s until the late 1990s has almost stopped. Among other problems, Canada's charge rate for impaired driving offences per licensed driver is relatively low, constituting less than 42% of the American rate as of 2010.

Various programs have been undertaken in Canada and the United States to encourage the public to report suspected impaired drivers to the police. The elements of these programs have varied, few programs were assessed, and the collected data were incomplete. In 2007, MADD Canada launched its national "Campaign 911" to encourage the public to report suspected impaired drivers. MADD Canada is the country's largest grassroots anti-impaired driving organization, giving its programs considerable reach.

Objectives
To review the pre-existing public mobilization programs, describe the key elements of MADD Canada's Campaign 911 and assess its reported impact.

Key Outcome
The results of MADD Canada's Campaign 911 have been promising. The reported benefits include: increased public perception of the risk of apprehension; increased public calls to the police regarding suspected impaired drivers; and increased police vehicle interceptions, provincial licence suspensions, federal impaired driving charges, and police follow-up with the owners of reported vehicles that were not intercepted (MADD Canada, 2012, slide 6).

Discussion and conclusions
The elements of Campaign 911 are consistent with the research on effective media, traffic safety and multi-component community campaigns (Babor et al, 2010, pp. 156-158, 200-202, 207-210; Elder et al, 2004; Phillips, Ulleberg & Vaa, 2011; Schults et al, 2009). Similarly, the focus on increasing police interception and charge rates is consistent with deterrence theory (Homel, 1993, p. 59; Nagin, 1998; Tay, 2005; Watson & Freeman, 2007). However, the specific features, intensity and duration of the individual campaigns vary, and data on these campaigns have not been collected on a consistent basis. Nevertheless, given the promising results to date, MADD Canada's Campaign 911 warrants a systematic review.

Introduction

Campaign 911 is not novel, as the public has been reporting suspected impaired drivers since the establishment of the first police emergency call systems. Virtually all jurisdictions now have a single dedicated phone number, such as 911, to receive public calls for emergency services. Typically, the number is linked to a call centre that prioritizes the calls and, where appropriate, dispatches the police, fire department and/or emergency medical services. The widespread use of cell phones has greatly increased the public's capacity to report incidents in a timely manner.

Campaign 911 builds on this existing infrastructure. It seeks to increase awareness of the public's role in detecting and apprehending suspected impaired drivers, the appropriateness of calling 911 to report suspected impaired drivers, and the information that should be reported. In turn, these measures should increase the number of public calls, the relevance of the information reported, and the number of suspects intercepted and subjected to provincial licence suspensions and criminal charges. In addition to the immediate removal of impaired drivers from the roads, Campaign 911 seeks to deter impaired driving by increasing the perceived risk of apprehension.

The pre-existing American and Canadian programs

There have been several initiatives in the United States to encourage reporting suspected impaired drivers to the police. In 2007, the National Highway Traffic Safety Administration (NHTSA) published a survey of these programs in 57 American states and territories. Of the 53 responding jurisdictions, 45 had a reporting program using the general emergency number, and six had a reporting program with a dedicated emergency number (Fiorentino, Cure, & Kipper, 2007, p. 2). In most cases, the public reports were directed to the appropriate police agency, regardless of whether the jurisdiction had a general emergency number or a dedicated number. Most of the jurisdictions simply noted that they had a reporting program and only answered a few additional questions, leaving the majority of the survey unanswered.

Nevertheless, there were some trends in the responses. Most jurisdictions promoted their programs using a combination of billboards, highway signs, patrol cars, television, and radio. The most common problems included: too few patrol cars to respond to calls; inadequate or incomplete information from callers; the time it took to find the reported vehicle; the lack of probable cause to stop the reported vehicle; and inappropriate calls. Only Colorado, Idaho and Washington reported evaluating their programs. However, the results of the evaluation were unknown in Colorado and dated in Idaho. Washington indicated that its program had resulted in an increase in arrests and a decrease in fatalities (Fiorentino, Cure, & Kipper, 2007, pp. 5-52).

The NHTSA study also sought detailed information on the impact of the specific programs, but again the data reported were very limited. For example, only seven jurisdictions provided information on three or more of the following questions, and only two jurisdictions provided information on all five questions (Fiorentino, Cure, & Kipper, 2007, pp. 53-62):

(i) How often is a patrol vehicle actually dispatched?
(ii) Average time between call and stoppage of vehicle?
(iii) Estimated percentage of calls resulting in arrest?
(iv) Estimated percentage of calls resulting in prosecution?
(v) Estimated percentage of calls resulting in conviction?

In Canada, programs encouraging the public to report impaired drivers are also popular. For example, a program called "Operation Lookout" began in the late 1980s and was sponsored by a series of Ontario community-based impaired driving groups. In 2006, the Ontario Community Council on Impaired Driving (OCCID), a charitable organization, assumed responsibility for Operation Lookout (Leonard, slide 3). The program components typically included road signs, billboards, PSAs, and ads in newspapers. The program provided information on how to identify and report a suspected impaired driver (Purnell, 2008, p. 6). Operation Lookout has been run in approximately 50 Ontario cities, towns and counties, but as in the United States, little information is available on the features, intensity or duration of these initiatives.

Although OCCID suggests that Operation Lookout has had significant traffic safety benefits, little supporting evidence is provided (Leonard, slides 2 and 14). A presentation on the Belleville, Ontario area Operation Lookout program reported the number of provincial licence suspensions and impaired driving arrests from 2000 to 2005, but did not indicate if or how this information related to the program (Jianopoulos, 2008, slide 5). A 2007 Grey Bruce Health Unit press release stated that public calls to the police concerning suspected impaired drivers increased 71% after the 2000 launch of the local Operation Lookout program (Grey Bruce Health Unit, 2007). A 1995 Peel Regional Police report indicated that public calls reporting suspected impaired drivers increased by 70% and that impaired driving incidents had decreased by 36% following the 1992 introduction of Operation Lookout (Peel Regional Police, 1995, p. 5).

The authors have been unable to find any other information on whether the Operation Lookout programs increased the number of public calls to the police, police interceptions of suspected impaired drivers, provincial licence suspensions or criminal charges.

MADD Canada's Campaign 911

Campaign 911 is a community partnership involving traffic safety organizations, the police, emergency call centres, public health units, insurance companies, municipalities, and the media. Campaigns have been initiated in communities in three provinces and one territory, and there are five province-wide Campaigns. In total, approximately 60 Campaign 911 programs, albeit sometimes using a different name,[1] are currently operating in cities, towns and communities across Canada (Kelly, 2013, pp. 3-4).

MADD Canada has released a guide on establishing an effective Campaign 911 program. The guide addresses the need for the police and emergency call centres to coordinate their activities and provide sufficient resources for the anticipated increase in calls concerning suspected impaired drivers. It emphasizes engaging and educating the public to maximize the number of helpful calls and the importance of large, high-visibility roadside signs and ongoing media initiatives. The guide also includes: educational materials on 10 signs of impaired driving; instructions on how to call safely and the information to be conveyed; and sample road signs, billboards, promotional materials, and other resources (MADD Canada, 2012, slides 7-11).

The guide sets out the key responsibilities of the police and community partners. The police responsibilities include: responding to 911 calls and intercepting reported vehicles; issuing provincial licence suspensions, laying criminal charges and following up with the owners of reported vehicles that were not intercepted; and collecting related statistics (MADD Canada, 2012, slides 9-10). The community partners are expected to undertake media campaigns, raise funds for 911 billboards and road signs, and educate the public and encourage them to view impaired driving as an emergency that warrants calling 911.

[1] These include the "Call-911 Campaign," the "Curb the Danger Program" and the "Report Impaired Drivers Program."

Unlike the American study and Operation Lookout, there is considerable information on the impact of at least some of the Campaign 911 programs, including those in two of Canada's largest municipalities. Moreover, most of the information is current to 2010 or 2011. However, there is only statistical information on nine of the programs, and the type of data reported varies. For example, in Saskatoon, Regina, Camrose, and Edmonton, the information is limited to the post-implementation period. In other cases, information is available on the number of pre and post-implementation calls, and the resulting police interceptions, provincial licence suspensions, criminal charges, and follow-up actions concerning vehicles that were not intercepted.

In the 12 months following the initiation of the program in Saskatoon (pop. 231,900) in 2010, the public made almost 3,000 calls to 911 concerning suspected impaired driving. The police intercepted 616 of the reported vehicles, and these police stops resulted in 240 provincial licence suspensions and criminal charges. The police also sent warning letters to the owners of 1,121 vehicles that had been reported but not intercepted (MADD Canada, 2012, slides 23-24).

Edmonton (pop. 730,000) initiated its Campaign 911 program in 2007. It generated 9,229 calls in 2010, which led to 3,392 vehicle interceptions, 1,174 provincial licence suspensions and criminal charges, and 1,192 follow-up letters to the owners of reported vehicles that were not intercepted (MADD Canada, 2012, slides 25-26). While calls (7,852), suspensions and criminal charges (969), and follow-up letters (584) declined in 2012 (Edmonton Police Service, 2013), the January to March 2013 statistics are somewhat more positive (Kelly, 2013, p. 5). In its first eight months beginning in October 2010, the Camrose (pop. 17,200) program received 192 calls, resulting in 101 vehicle interceptions, 34 provincial licence suspensions and criminal charges, and 23 follow-up letters (MADD Canada, 2012, slides 29-30).

Following the York Regional Municipality's implementation of the program in 2006/07, the average annual number of 911 calls about suspected impaired driving and resulting criminal charges increased by 59% and 81%, respectively (MADD Canada, 2012, slides 19-20). In the year after the 2008/09 launch of Calgary's program, 911 calls concerning impaired drivers and resulting criminal charges rose by 80% and 28%, respectively (MADD Canada, 2012, slide 22).

In Ottawa, 911 calls reporting suspected impaired drivers increased by 43% following the December 2009 implementation of the program (MADD Canada, 2012, slide 28). In Nanaimo, the 2009 launch of the program was credited with increasing 911 calls concerning suspected impaired driving by 110% and resulting provincial licence suspensions and criminal charges by 100% and 33%, respectively (Kelly, 2013, p. 2). In the year following the 2011 launch of the Brandon campaign, total calls (911 and general police number) concerning impaired driving suspects increased 47%, vehicle interceptions increased 79%, and provincial licence suspensions and criminal charges increased 48% (Kelly, 2013, pp. 10-11).

Conclusion

MADD Canada's Campaign 911 is not novel, but it appears to be comprehensive, integrated and well resourced. It is currently operational in more and larger communities than Operation Lookout, which is mostly confined to Ontario. Campaign 911 is consistent with the research on effective media, traffic safety and multi-component community campaigns. It stresses the importance of using high-visibility signs, undertaking ongoing intensive promotional activities, educating and mobilizing the public, establishing partnerships with senior police officials, and building broad community coalitions. In accordance with deterrence theory, Campaign 911 focuses on increasing the number of vehicle interceptions, provincial licence suspensions, impaired driving charges, and police follow-up contacts with the owners of reported vehicles that were not intercepted.

Following implementation of the Campaign 911 programs, the number of public calls regarding suspected impaired drivers sharply increased, as did the number of resulting vehicle interceptions, provincial licence suspensions, criminal charges, and police follow-up actions. The large highway signs and related promotional initiatives have likely increased public awareness of the impaired driving issue and the public's perception of the risk of apprehension. Similarly, the increases in vehicle interceptions, provincial licence suspensions, criminal charges, and police warning letters have probably had a deterrent impact.

However, there is statistical information on only nine of the approximately 60 Campaign 911 programs and, of these, only five include pre and post-implementation data. Moreover, the statistics in these five campaigns have not been collected and reported in a consistent manner. As indicated, the programs are initiated on a local level, and there is little information on their specific features, intensity, costs, and duration. Most of the Campaign 911 programs are relatively new, and it cannot be assumed that their current impact will be sustained.

While the information on Campaign 911 is limited, the results to date have been promising. Consequently, in our view, MADD Canada's Campaign 911 warrants a systematic review.

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Developments in Canadian community-based impaired driving initiatives: The Ontario “Last-Drink Program”

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Abstract

Context
A disproportionate number of impaired drivers come from licensed establishments, as opposed to their own homes or other private venues. “Last Drink” programs focus liquor licensing enforcement on high-risk establishments in an attempt to reduce impaired driving and other alcohol-related incidents. Pursuant to the program, the police ask impaired driving suspects where they were drinking. If a licensed establishment is named, the information is forwarded to licensing officials for follow-up action.

Objectives
This paper outlines the rationale for implementing Last Drink programs and summarizes the limited research on their impact. It describes Ontario’s mandatory Last Drink program and the preliminary results of the pilot project on which it was based.

Key outcomes
A large percentage of impaired drivers in the Ontario pilot project came from a small percentage of the licensed venues. The Alcohol and Gaming Commission of Ontario (AGCO) described the program’s preliminary results as “encouraging on multiple fronts,” and Mothers Against Drunk Driving (MADD) Canada and other safety organizations endorsed it. Ontario subsequently introduced a mandatory province-wide Last Drink program.

Discussion and conclusions
Last Drink programs appear to temporarily improve serving practices in the targeted venues. However, it is unclear if these initiatives have a lasting impact on the targeted establishments, the broader hospitality industry or the incidence of impaired driving.

Introduction

Licensed venues account for about 20% of total alcohol consumption in Canada (Babor et al., 2010, p. 32), but play a far greater role in impaired driving. A similar pattern is evident in the United States and Australia. For example, one American study reported that between two-thirds and three-quarters of intoxicated drivers stopped by police had their last drink at a licensed establishment (Stewart & Sweedler, 2007, p. 4), while another American study put the figure at up to 50% (Moore, 2007, p. 177). In New South Wales, approximately 50% of impaired driving offenders had been drinking in a licensed premise prior to the offence (Rydon, Stockwell, Syed, & Jenkins, 1993, p. 339). Not surprisingly, licensed establishments are similarly overrepresented in alcohol-related crashes (Willingham & Mosher, 2013, slide 31).

An early Ontario roadside survey reported that while only 6% of the drivers were coming from bars or taverns, they accounted for 16% of the drivers with BACs between .05% – .08%, and 16% of those with BACs above .08% (Single & McKenzie, 1992, p. 3). In a 2001

Alberta nighttime roadside study, drivers coming from bars and taverns were five times more likely to be legally impaired than drivers coming from all other locations (Belton, Voaklander, MacDonald, & Jhangri, 2001, p. 3). Similar results were evident in the 2003, 2008 and 2010 British Columbia roadside surveys (Beirness & Beasley, 2011). Moreover, binge drinking (i.e. consuming five or more standard drinks in a single sitting), which strongly correlates with impaired driving, is commonplace in licensed establishments, particularly bars and taverns (Rydon et al., 1993).

Enforcing liquor licence legislation

It has long been illegal in Canada for licensed establishments to serve alcohol to patrons who are or appear to be intoxicated, or to permit "drunkenness" on the premises. These stringent prohibitions date from colonial times and remain subject to potentially severe penalties. Moreover, even in the absence of a charge, licensing officials have broad administrative authority to suspend or revoke a licence if the licensee has breached the liquor act, its regulations or any conditions of the licence. Finally, the police and liquor licence inspectors are authorized to enter and search any licensed premises without a warrant, demand documentation and seize evidence of any offence. Licensing officials clearly have broad investigatory powers and ample legal authority to ensure compliance with the legislation.

Some studies indicate that increased enforcement in licensed establishments reduces the number of over-served patrons and impaired drivers originating from these venues. A Swedish project involving enhanced licensing and police enforcement increased the rate of service denial to intoxicated patrons from 5% in 1996 to 47% in 1999, and then to 70% in 2001. Moreover, crimes in the intervention area fell an estimated 29% compared to a slight increase in the control area (Wallin, Lindewald, & Andreasson, 2004, pp. 409 & 411).

Other studies on enhanced enforcement are more equivocal. For example, one study stated that "targeted responsible beverage service programs combined with enforcement may have an impact on traffic safety" (Stewart & Sweedler, 2007, p. 5). Another study reported that "enhanced regulation and enforcement … cannot be relied on to prevent all, or even most, problems" (Mann et al., 2009, p. 12). A recent review concluded that "there is insufficient evidence to determine the effectiveness of over-service law enforcement initiatives as a means to reduce excessive alcohol consumption and alcohol-related harms" (Task Force on Community Preventive Services, 2011, p. 345).

The alcohol industry and others have suggested various alternatives to enhanced enforcement, such as self-regulation of marketing, industry accords and industry-sponsored responsible consumption campaigns. These measures have either proven to be ineffective or there is little evidence of their efficacy (Babor et al., 2010, pp. 159-162; Anderson, Chisholm, & Fuhr, 2009, pp. 2237-2239; Dejong, Atkin, & Wallack, 1992). While some research indicates that responsible beverage service programs have a positive effect, particularly when coupled with intensive enforcement (National Highway Traffic Safety Administration [NHTSA], 2013, pp. 1-46 & 1-47), other studies have not found these programs to be effective (Ker & Chinnock, 2008; Hughes, Furness, Jones, & Bellis, 2010, pp. 10-12).

Last Drink programs

Introduction
Last Drink programs can be designed to address various problems stemming from licensed

establishments, including alcohol-related violence and impaired driving. For example, when the police apprehend an impaired driver, they ask the driver where he or she had been drinking. If the driver identifies a specific venue, that information is forwarded to the licensing authorities for follow-up. This may range from issuing a warning letter and increased visits by police and regulatory officials, to taking disciplinary action. These measures serve to encourage or force licensed establishments to improve their serving practices (Sim, Morgan, & Batchelor, 2005).

The international experience

There is limited research on the effectiveness of Last Drink programs. While there are some positive results in terms of the immediate effects of these programs, their lasting impact on hospitality industry practices and impaired driving remains to be determined.

Two American studies have reported positive short-term results. Washtenaw County, Michigan, initiated a Last Drink program in 1990. Enforcement was increased for 12 months and focused on the 10 most problematic establishments. The rate at which "'pseudopatrons' simulating intoxication" were refused service rose from 17.5% to 41.0% at the end of 12 months (McKnight & Streff, 1994, p. 82). The percentage of suspects arrested for impaired driving who reported coming from licensed establishments fell from 31.7% to 23.3% one year after the increased enforcement initiative began. This percentage remained largely unchanged in three comparison counties (p. 83).

A study of the impact of intensified enforcement on Washington State's Last Drink program reported "mixed" results (NHTSA, 2008, p. 4). Although the authors detected no change in retail practices, there were two promising findings. First, the monthly average number of impaired driving arrestees who reported coming from a targeted venue decreased 36% following the intensive enforcement period (p. 9). The comparable decrease in the non-targeted (control) venues was 7% (p. 9). Second, the average BAC of arrestees originating from targeted establishments decreased from .135% to .127%, while there was a modest increase in the control establishments (p. 11).

In the mid-1990s, New South Wales implemented the "Alcohol Linking Program," requiring the police to determine if suspects arrested for any offence had been drinking. If so, the police recorded where the suspect had his or her last drink and followed up with any named venues (Wiggers et al., 2004). A study of this program reported that 10% of the establishments accounted for 50% of the people involved in police-attended incidents arising from licensed venues. Following the adoption of an enhanced enforcement program, the number of intoxicated individuals coming from licensed venues who were arrested for an alcohol-related crime fell by up to 22%. The enhanced program involved more intensive enforcement, an audit of the establishment's serving practices, individualized recommendations, and police follow up (p. 360). This study did not address the impact of the program on impaired driving.

Wellington, New Zealand implemented an enforcement program based on Last Drink information and police intelligence. A study on the impact of increased police and licensing enforcement in licensed establishments reported that it "may have contributed to a reduction in the number of highly intoxicated persons" (Sim et al., 2005, pp. ii-iii). During the intensified enforcement periods, disorder and violent offences decreased (p. 58). Again, the study did not address the impact of the intensified enforcement program on impaired driving.

The Canadian experience
In response to "unacceptably high" rates of impaired driving in the early 1990s, Peel Regional Police and licensing authorities initiated what became known as the "Last Drink Campaign." Licensees named by intoxicated suspects were subject to closer scrutiny and progressive disciplinary action, which included sending licensees advisory letters and reference materials, conducting full investigations and initiating disciplinary action (Peel Regional Police, 1996, p. 4). In praising the program, both the police and licensing authorities noted that it allowed them to more efficiently use their resources and enforce liquor laws (p. 4). However, the program was not formally assessed, and no data were provided on whether it reduced the incidence of impaired driving in the region or the percentage of impaired drivers who were coming from licensed venues. Only one statement was made in this regard, namely: 19 impaired driving arrestees reported coming from a particular venue, and this number fell by 50% once the Last Drink program was fully implemented (pp. 4-5). While this was cited as an achievement, one could draw the opposite conclusion and question why this venue still had a liquor licence.

Several municipal police departments and the AGCO launched a large Last Drink pilot project in 2012. During this period, 3.6% (7 of the 196) of the identified licensed establishments accounted for 26.5% of the suspects who were either arrested for a federal impaired driving offence or given a provincial administrative licence suspension for having a blood-alcohol concentration (BAC) between .05% and .08% (O'Halloran, 2012, slide 8).[1] The named establishments were subject to escalating AGCO interventions.[2] As well, 22 establishments were added to the AGCO's "Risk-Based Enforcement List," resulting in increased inspections (slide 9). As with the Peel program, the police and licensing officials strongly endorsed the project without providing any data on its impact.

Based on the pilot project, the Ontario Chiefs of Police and the AGCO introduced a mandatory province-wide Last Drink program. As of August 6, 2012, all police were required to report to the AGCO any death or serious injury that could be linked to drinking at a licensed establishment or event, whether or not it was traffic related. The police were also encouraged to report to the AGCO any alcohol-related offence, such as impaired driving and public intoxication, which could be linked to an identified licensee (AGCO, 2012).

Conclusions

In Canada, a disproportionate share of impaired drivers apprehended by the police are coming from licensed premises, with much of the problem attributable to a small number of high-risk licensees. Last Drink programs are designed to identify these high-risk venues and subject them to increased scrutiny and enforcement. The limited research to date suggests that Last Drink programs can temporarily reduce service of alcohol to apparently intoxicated patrons and the number of impaired drivers leaving targeted establishments. It remains to be determined whether these positive results are due to the Last Drink program itself or to the intensive enforcement that accompanies it. Nor is it clear if Last Drink programs have an

[1] The numbers reported in the presentation are inconsistent. Consequently, the numbers reported on slide 8 and 11 cannot be reconciled with those on other slides.

[2] On a first report, a liquor inspector meets with the licensee to inform him or her of the incident. On a second report, an inspector meets with the licensee and reviews the prohibitions against permitting drunkenness and over-serving patrons. On a third report, an inspector meets with the licensee, and explains that the venue is being placed on the Risk-Based Enforcement List and will be subject to increased inspections. Moreover, a formal warning letter is sent to the licensee.

ongoing impact on the targeted venues, the broader hospitality industry or the incidence of impaired driving. While Last Drink programs have intrinsic appeal, the critical issue appears to be whether the police and licensing authorities are willing to use their broad enforcement authority to compel compliance.

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Are more city dwellers caught drink driving than country folk? An analysis by random breath testing apprehension rates.

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Abstract

Background
Random Breath Testing (RBT) remains a central enforcement strategy to deter and apprehend drink drivers in Queensland (Australia). Despite this, there is little published research regarding the exact drink driving apprehension rates across the state as measured through RBT activities.

Aims
The aim of the current study was to examine the prevalence of apprehending drink drivers in urban versus rural areas.

Methods
The Queensland Police Service provided data relating to the number of RBT conducted and apprehensions for the period 1 January 2000 to 31 December 2011.

Results
In the period, 35,082,386 random breath tests (both mobile and stationary) were conducted in Queensland which resulted in 248,173 individuals being apprehended for drink driving offences. Overall drink driving apprehension rates appear to have decreased across time. Close examination of the data revealed that the highest proportion of drink driving apprehensions (when compared with RBT testing rates) was in the Northern and Far Northern regions of Queensland (e.g., rural areas). In contrast, the lowest proportions were observed within the two Brisbane metropolitan regions (e.g., urban areas). However, differences in enforcement styles across the urban and rural regions need to be considered.

Discussion and conclusions
The research presentation will further outline the major findings of the study in regards to maximising the efficiency of RBT operations both within urban and rural areas of Queensland, Australia.

Introduction

Drink driving continues to be a major cause of death and injury on Australian roads. Analysis of crash data from 2006 found alcohol to be a factor in approximately one-third of all road traffic deaths (BITRE, 2011) and that alcohol and/or drug use was a factor in over half (52%)

of fatal sole occupant, single vehicle crashes (BITRE, 2011). Internationally it has been recognised that establishing Blood Alcohol Concentration (BAC) limits of 0.05g/dl or below in combination with RBT operations are an effective method by which to reduce the number of alcohol-related crashes (WHO, 2013). The use of checkpoints and RBT can lead to significant reductions in alcohol-related crashes and have been shown to be very cost-effective method to reduce alcohol related road trauma (WHO, 2013).

RBT operations commenced in Australia when this approach was first introduced in Victoria in 1976. Across Australia, a BAC of 0.05g/100mL (or 0.05 per cent) has been set as the legal limit for full licence holders, with lower rates applicable for other drivers: zero for learner drivers and provisional drivers. When conducting RBT operations, police officers randomly stop motorists to obtain an initial analysis of their breath via a hand held device to determine whether they have consumed more alcohol than is legally permitted to operate a motor vehicle. Subsequent tests confirm the degree to which alcohol is present. Since the introduction of RBT, a 55% reduction in the number of crash fatalities occurring in Queensland has been observed despite the considerable growth in population during this time (BITRE 2102). The use of RBT programs is regarded as contributing greatly to this decline.

In Australia there is general support for harsh penalties for drink drivers (AIHW, 2005; AIHW, 2008; Hommel, 1990). However, for many motorists, possible apprehension by police does not deter them from drink driving despite recent exposure to RBT operations (Watson & Freeman, 2009). It is of interest to note that research has found that the drivers most likely to believe that they have a low risk of being apprehended for drink driving are males under thirty years of age and rural drivers (Harrison & Pronk, 1998). Indeed, drink-driving offenders in rural areas have reported a preference for changing their driving habits rather than change their drinking habits to avoid detection in the future (Ferguson, Schonfeld, & Sheehan, 1999). In addition, surveys of drivers in rural areas indicate relatively low levels of support in regards to the perceived effectiveness of RBT operations (Sheehan et al., 2008).

Generally driving behaviours in rural and remote regions have not received the same degree of scrutiny as that of urban motorists, despite evidence that drivers in these regions have a greater risk of involvement in a crash. A recent study from the United States found that fatal crashes in rural areas accounted over half (56%) of all traffic fatalities in 2006 despite the fact that at that time less than a quarter (23%) of the population lived in rural areas (population centres below 50,000 inhabitants) (National Highway Traffic Safety Administration, 2007). In Australia, the proportion road deaths occurring in rural and remote areas increased noticeably in the period between 1992 and 2006 (FORS, 1996; Australian Transport Council, 2011). While a number of contributory factors may explain findings such as these, including road conditions and higher speed limits, a greater willingness to engage in risk-taking behaviours does appear to be a factor in the comparatively large proportion of crashes on rural roads. Drivers in rural areas have been found to have strong associations with crashes involving high levels of alcohol consumption, excessive speed and a failure to wear seat belts (Pettitt, Baade, Low Choy, Darnell & Haynes, 1994; Sahai et al., Sahai, Pitbaldo, Bota & Rowe, 1998; Hasson, 1999; Tziotis, Mabbott, Edmonston, Sheehan & Dwyer, 2005; National Highway Traffic Safety Administration, 2008).

For many Australians, the consumption of alcohol is an integral part of their lives, with up to ten percent of Queenslanders drinking alcohol daily (DTMR, 2010). In fact the rate of alcohol related deaths and hospitalisations are higher in Queensland than in most other parts of Australia (DTMR, 2010). Regular and excessive drinking of alcohol can be particularly prevalent in many rural communities (Sheehan, Schonfeld, & Davey, 1995; Sheehan et al., 2008). In a major study of crashes, driver attitudes and behaviours in rural and remote areas in North Queensland (Sheehan et al., 2008) problem drinking and alcohol involvement were found to be a major contributor to crashes in this region. Driver related factors were found to contribute to crashes to a much greater extent than environmental factors, with a majority of crashes involving single vehicles and occurring in relatively good road and climatic conditions (Sheehan et al., 2008). Alcohol was deemed to be a contributing factor in fatal crashes at approximately twice the rate of that recorded for other serious crash types (Sheehan et al., 2008). In addition, contrary to the commonly held views, the large majority of crashes involved (and caused) by locals rather than by tourists or visitors to the region (Sheehan et al., 2008).

Differences can exist between rural and urban areas in the prevention, detection and intervention of drink driving (Harrison, 1996; Sheehan et al., 2008; DTMR, 2010) with a range of social, environmental and geographical factors reflected in drink driving behaviours. These factors include: perceptions of a lower probability of detection in rural areas; a higher degree of social solidarity in many smaller rural communities; a relative scarcity of traffic enforcement personal and related support available in rural areas; traffic law enforcement tends to be more expensive on low traffic volume roads and; less alternatives to drink driving (such as public transport) are present (Elliott & Shanahan, 1983; Harrison, 1996; Travelsafe, 1999). In rural areas, police can also face problems in transporting a detained or arrested drink driver to a location with suitable breath analysis device within the two-hour time frame as required by existing protocols (DTMR, 2010).

Method and Results

The dataset contained information for all drivers stopped and processed as part of the Queensland RBT legislative framework from 1 January 2000 to 31 December 2011. The data collected occurred within the state's eight defined police regions, covering the total Queensland population of 4,349,631 (Australian Bureau of Statistics, 2011).

In the period, 35,082,386 random breath tests (both mobile and stationary) were conducted in Queensland which resulted in 248,173 individuals being apprehended for drink driving offences. Examination of data across the eight police regions over the twelve-year period shows that the prevalence of drink driving detection rates rose steadily across time, peaking in 2008 and 2009, before slightly declining. This decline was observed across all Queensland regions with any increase in annual figures reflecting the introduction of new offence types.

The highest rate of detections per number of interceptions over the period 2000 to 2011 was observed in the Northern (1:83) and Far Northern (1:85) police regions respectively (rural areas). Conversely, the lowest rate of detections was observed in the Metropolitan South (1:149) police region (urban area) (see Table 1).

Table 1: Roadside breath tests and offence detections by Queensland police region, 1January 2000 to 31 December 2011.

Police Region	No. Tests	% total tests	No. RBT offences	% total RBT offences	RBT Detection rate	Qld Population (as at 30 June 2011)	% of Qld Population
Far Northern	2,759,187	8%	32,639	10%	1:85	276,515	6%
Metropolitan North	4,918,340	14%	44,016	14%	1:112	656,725	15%
Metropolitan South	5,368,599	15%	36,146	11%	1:149	724,089	17%
North Coast	6,705,895	19%	57,152	18%	1:117	848,544	20%
Northern	2,343,446	7%	28,342	9%	1:83	282,306	7%
South Eastern	5,511,400	16%	57,624	18%	1:96	842,057	19%
Southern	4,041,794	12%	31,355	10%	1:129	513,191	12%
Central	3,433,725	10%	32,759	10%	1:105	206,204	5%
Total	35,082,386	100%	320,033	100%	1:110	4,349,631	100%

Discussion

Examination of offences by number of tests conducted revealed that regional areas such as Northern and Far Northern shows a detection rate far in excess of that observed in the far more populist, urban areas in the south east corner of Queensland such as Metropolitan South, Metropolitan North and the North Coast areas. It is of interest to further examine why the rate of detection in rural areas is higher and determine appropriate countermeasures to reduce the incidence and severity of drink driving in these communities.

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Alcohol interlocks, recidivism prevention and self evaluation of alcohol problems.

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Methodology

Overall, 409 French drivers from Haute-Savoie were included in this study. All of them were caught by police forces while driving with a Blood Alcohol Content exceeding 0.8 g/l between 2006 and 2011.

Experimental group: 175 drivers (12% women, mean age: 38.8) participated to a 6 month rehabilitation program and constituted our experimental group. The possibility to be included in the program was offered by the prosecutor to some offenders only. The prosecutor decided to offer the possibility to participate in the program according to the following criteria: were excluded from the program those who were recidivists (for years 2007-2010), were caught with a very high B.A.C. (over 2g/l), didn't own their vehicle, were caught committing multiple offenses (run away, outrage, no driving license, attempted bribery, etc.), were in their driving license probation time, were caught after they caused an accident. Indeed, drivers whose offense was associated with such aggravating circumstances were judged unfit to benefit from this measure, seen as too merciful for them by the prosecutor.
Some offenders rejected the offer, most often because of financial motives: they were indeed required to pay 1200 Euros for the interlock device.
Control groups included all the drivers (n = 234) arrested for an alcohol offense during the month of February of the corresponding year (see table 2). In order to avoid potential bias in this sample, we checked for drivers origins and found that they were all locals from Haute-Savoie. Although control and intervention groups were not perfectly matched, the differences regarding key demographics were small (13.2% women, mean age: 36.9).

Table 2. Number of participants for each group

Year	Experimental group	Control group
2006	19	31
2007	30	39

2008	39	49
2009	37	41
2010	31	36
2011	19	38
Total	175	234

Results

There were less drivers aged between 18 and 24 years old ($\chi^2 = 8.05$, $p < .05$) in the interlock program group (8.6%) than in the control group (18.5%). This may be due to the program cost (1200 Euros) which may be less affordable for the youngest offenders and to the fact that young offenders were more likely not to own their car.

The proportion of women in any group was by far lower than men's and no difference was found between experimental and control groups ($\chi^2 = .14$, $p = .71$). This is a predictable outcome if one considers the literature on gender differences and compliance to gender stereotypes, particularly in regard to alcohol consumption and drunk driving (Assailly, 2012).

By cons, when committing the offense, the B.A.C. of women were very important (1.7 g/liter in average for the 2011 control group), as important as those of men ($F(1,400) = 1.41$, $p = .24$).

We saw no difference in the proportion of women between 2006 and 2011 in our sample ($\chi^2 = 3.32$, $p = .65$).

We observed in our sample that the B.A.C. at the arrest ($M = 1.53$) were well above the legal limit in France (0.5 g/l). The B.A.C. was not an inclusion criterion for the interlock program (except for very high B.A.C. over 2 g/l of blood) and we see average B.A.C. 's are not different ($F(1,400) = 1.5$, $p = .22$) between the experimental ($M = 1.5$) and control ($M = 1.56$) groups.

Table 3. Descriptive variables of samples.

	Mean B.A.C. g/l		% women		Mean age		% previous recidivism	
Year/Group	AIP	ctrl	AIP	ctrl	AIP	ctrl	AIP	ctrl
2006	1.58	1.62	5%	16%	37.2	37.2	21%	29%
2007	1.39	1.56	7%	20%	40.9	38.7	0%	33%
2008	1.47	1.46	15%	6%	40.2	35.1	10%	31%
2009	1.56	1.61	8%	14%	35.5	38.2	13%	45%
2010	1.48	1.58	16%	6%	40.2	39	21%	37%
2011	1.59	1.56	21%	18%	37.8	33.5	21%	32%
Total	*1.50*	*1.56*	*12%*	*13%*	*38.8*	*36.9*	*13%*	*35%*

Note: AIP: Alcohol Interlock Program, ctrl: control group.

We assessed two kinds of recidivism:

- Recidivism obtained prospectively: one (or several) alcohol violation(s) has been committed again after the year of the driver's cohort;
- Recidivism obtained retrospectively: we discover in the files that one (or several) alcohol violation(s) had been committed before the year of the driver's cohort;

Recidivism is by nature a phenomenon very difficult to observe, in fact the "real" recidivism rate will never be known as it would suppose to monitor permanently all the drivers in their vehicle, whether in interlock programs or in control groups. Repeat offenders are those who have not changed their behaviour, at least not enough to avoid recidivism.

The probability of detection every time some of us are committing the drunk driving offense is always rather low, so we can only approach the phenomenon.

The recidivism rate of interlock program participants increases with the number of years of follow-up (see table 4); this is logical, as the probability of detection being low, the more years the more probability of being caught again. We must mention here that the legal definition of recidivism in France is a reoffending in the 5 years following an offense. We saw that for the year 2006, for which we had a follow-up on 5 years, the difference between the experimental (26%) and the control group (35%) was small. Nevertheless we should note that, taken as a whole, recidivism is lower in experimental group than in control group (χ^2=13.7, p<.001).

The main difference between the interlock group and the control group is for the recidivism rate obtained retrospectively (table 3): nearly null in the interlock program, whereas it reaches approximately one third for the control groups. However, this only reflects a selection bias as the prosecutor was not proposing the program to drivers having already committed this offense in the past.

The retrospective recidivism rate of 30% obtained on this population is a result which seems in line with those reported by Robertson et al (2009): "*unfortunately, determining the number of repeat offenders with any precision is not possible. Data indicate substantial variation in repeat offender rates, from about 20% to almost 50%. On average, about one-third of drivers arrested for DUI have a prior DUI conviction*".

We see also that with the long follow-up of 5 years, prospective recidivism is close to retrospective recidivism and around 30%. For control group in 2006, only 15 drivers out of 31 had neither retrospective nor prospective recidivism, that is to say that the global recidivism rate is 48.4%.

Table 4. Prospective recidivism rate for each group (measured in December 2011).

Year	Alcohol Interlock Program group	Control group
2006	26%	35%
2007	8%	33%
2008	7%	2%
2009	4%	2%
2010	5%	3%
2011	0%	3%
All	3%	12%

Table 5 shows that there are some differences in recidivism according to participants' occupation. It seems that manual workers and unemployed are more prone to recidivism than other occupational categories. Manual workers also seem to resist more to the program effects since a large proportion of them (38%) are still reoffending after the program. However, samples for each category are small and this result would need confirmation by further studies.

Table 5. Recidivism rate by occupation (years 2006 and 2007).

		All		**AIP**		**Control**	
		recidivism		recidivism		recidivism	
		no	yes	no	yes	no	yes
Artisans, merchants and entrepreneurs	N	11	2	7	0	4	2
	%	85%	15%	100%	0%	67%	33%
Managers and intellectual professions	N	16	3	15	1	1	2
	%	84%	16%	94%	6%	33%	67%
Intermediate occupations	N	7	2	3	1	4	1
	%	78%	22%	75%	25%	80%	20%
Employees	N	22	3	6	0	16	3
	%	88%	12%	100%	0%	84%	16%
Manual workers	N	19	16	10	6	9	10
	%	54%	46%	63%	38%	47%	53%
Retirees	N	4	0	0	0	4	0
	%	100%	0%	0%	0%	100%	0%
Other persons without occupation	N	7	6	0	0	7	6
	%	54%	46%	0%	0%	54%	46%
Total	N	86	32	41	8	45	24
	%	73%	27%	84%	16%	65%	35%

Data on the evaluation of the course (only for 2011 subjects)

The participants included in the alcohol interlock program in 2011 showed very little difference in their evaluation of the program as well as in their scores on the questionnaire. They all claim a positive attitude and a favourable orientation regarding Prochaska's processes of change. These results are very close to those found within the DRUID project (Bukasa et al, 2009).

Some slight differences have been found (see table 6) for some variables such as education level, gender and car habitual use (for commuting, professional journeys or both). The variable which seems to discriminate the most between the participants' scores on the questionnaire is their attitude regarding what was the most useful factor in the program. However these effects don't follow a clear pattern and may be linked to the small sample size for each condition of this variable.

Table 6. Mean scores for each processes of change.

		N=	Consciousness raising	Dramatic relief	Environmental reevaluation	Self reevaluation	Social liberation	Self liberation	Stimulation control	Counter conditioning	Helping relationships	Reinforcement management
Which aspect did	The recall of the law	15	1,43	1,49	1,98	1,53	1,20	1,53	1,23	1,33	1,07	2,00

you found to be the most useful?	The interlock equipment	11	1,32	1,61	2,15	1,73	1,55	1,68	1,36	1,64	1,27	1,82
	The course	16	1,38	1,50	1,90	1,50	1,75	1,41	1,53	1,50	1,31	2,00
	The follow-up	10	1,40	1,60	2,00	2,00	1,30	1,70	1,30	1,70	1,50	2,00
	The fear of sanction	6	1,33	1,39	1,61	1,50	1,67	1,42	1,42	1,17	1,67	2,33
Why do you need to drive the equipped car?	Commuting	10	1,47	1,50	1,90	1,30	1,50	1,35	1,35	1,30	1,30	2,40
	Professional trips	26	1,35	1,58	1,92	1,65	1,54	1,50	1,44	1,58	1,27	1,65
	Both	20	1,38	1,47	2,02	1,77	1,41	1,68	1,30	1,45	1,36	2,23
Gender	Men	49	1,39	1,54	1,97	1,59	1,51	1,55	1,39	1,49	1,33	1,92
	Women	9	1,31	1,41	1,85	1,89	1,33	1,50	1,28	1,44	1,22	2,44
Age	under 35 ans	19	1,34	1,60	2,02	1,68	1,58	1,50	1,32	1,47	1,37	2,05
	35 ans and more	39	1,40	1,49	1,92	1,62	1,44	1,56	1,40	1,49	1,28	1,97
Education level	High school or lower	34	1,40	1,60	1,94	1,71	1,53	1,54	1,41	1,53	1,35	1,88
	Bachelor or higher	24	1,35	1,42	1,97	1,54	1,42	1,54	1,31	1,42	1,25	2,17
	Total	58	1,38	1,52	1,95	1,64	1,48	1,54	1,37	1,48	1,31	2,00

Notes: Grey shade indicate a significant χ^2 at $p<.05$. A low score indicates a high level of agreement.

Discussion and conclusion

Our study is the first evaluation of the first interlocks program in France.
Some of our results confirmed previous ones in the literature. Indeed,
- The male vulnerability concerning alcohol-related violations;
- The very high B.A.C. 's of the hard core of drunk drivers

We have seen that female B.A.C. were as high as male offenders' ones. Two factors may determine this last phenomenon:
- a given consumption produces higher blood alcohol levels in women than in men;
- subjects that do not express the typical behaviour of their sex (here, in this case drunk driving, or just drink large amounts of alcohol for women) express it strongly, up to exploit (for sport) or deviance (for addictions or transgressions).

robust phenomenon observed in Australia where the traditional gender-related difference concerning alcohol use, alcohol violations and alcohol-related accidents is decreasing at the moment (Abbott-Chapman, Denholm & Wyld, 2008); this phenomenon was for the moment much less visible in Latin countries.

So, it seems that once the rule about alcohol is not respected, there is no limit to the transgression … The question remains of course to know if these very high B.A.C.'s indicate a chronic use of alcoholics or an unusual excessive drinking of non alcoholic subjects.

Other results bring new lights:
- The study of recidivism is a complex one, as we have seen it depends if you look "backward" or "forward". Concerning the evaluation of this first French interlock program, we could say that the benefit of the interlock in terms of reduction of recidivism is not very obvious on these populations; however, as the literature has shown, "dry" interlock programs – with the device installation but without a medical/psychological monitoring – produce an effect only while the device is installed, otherwise the recidivism rate becomes again similar to the control group's one. Here, the monitoring was probably insufficient (the usual 2 days awareness courses of the demerit point system) to create a significant difference between interlock program participants and control subjects.

So, the future work of traffic safety research in this domain will be to study more precisely the subgroups among these populations and to see how they react to the interlock programs: what kind of “matching” will be necessary between type of offender and type of program; we should not probably propose the same type of programs to young and old people, to alcohol dependent drivers and to exceptionally excessive drinkers, to “multi-type” offenders and to “alcohol only” offenders, etc.
What makes the programs work? Under the same title of “interlock program”, we have seen that various factors are equally important: some of the drivers said the device in itself may be the cause of improvement, others evoke the recall of the law, others have been more swayed to the 2 days driver improvement course, and finally some others liked the monitoring by program leaders. We have seen also that these variables are maybe those which are the more associated with the Prochaska’s factors of change. So, then again, we should in the future compare subgroups to see how these factors interact.
Though this was not in the initial focus of this study, we have mentioned to aspects of risk evaluation and perception by alcohol offenders which should be important to tackle in future prevention and education programs:
- The self evaluation of B.A.C. , the under-estimation and the defense mechanisms;
- The biased risk perception of detection circumstances.
The application of the DRUID methodology to the evaluation of this program is only here in a very preliminary phase; we may suggest the following hypotheses:
- With a 2 days only course, some processes of behaviour modification may appear sooner than others: for example, consciousness raising can be more rapidly obtained, whereas environmental reevaluation may be slower (to realize that our own use of alcohol has negative consequences around us needs a bit of empathy!); in the same way, reinforcement management may be even slower: to change of friends and to socialize with people who find positive not to drink and drive takes even more time! This is what scores seem to indicate.
- Whatever is the behaviour modification process, several factors impact on their effects: age, gender, dependence to car, academic level, etc.
The application of the Prochaska et al’s model will be probably more fruitful in the future with psychologists more involved in the accompaniment of interlock programs.

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Conflict of interest: none

Worldwide trends: France 2010/2012 and the PERLE Study

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Background

Recent trends in France

Preliminary note : French data about the presence of alcohol in casualties is classified into 3 categories :

.accidents with a positive BAC (at least one of the drivers is over the legal limit of 0.05%)
.accidents with a known legal BAC (all the drivers have a known and legal BAC)
.accidents with an unknown BAC

In 2010, unknown BAC's were for 20% of casualties and 22% of fatalities; in 2011 of 20,4% of casualties and 20.7% of fatalities. The situation is not improving on this point !

Methods

In the rest of this paper, statistics are produced in France only on accidents with a known BAC and exclude also drunk pedestrians (as screening by police is far from systematic).

Results

In 2011, 30% of fatal accidents are .accidents with a positive BAC (at least one of the drivers is over the legal limit of 0.05%), compared to 11% of casualties. This confirm as every year the link between alcohol and accident severity (for example, illegal BAC's are present in 9% of light injuries and 15% of severe injuries).

There is only a decrease of 1% between 2010 and 2011, and as the proportion was already 30% in 2000, we see clearly that we have made no progress since all these years concerning alcohol : it is always present in 30% of accidents, but, as we have progressed since 2000 from 8000 fatalities to 4000, alcohol related fatalities now represent one third of 4000 instead of one third of 8000. In fact, we have impacted on alcohol related accidents with a measure which is not all specific to drinking : speed cameras ! With the same number of alcohol offenders, they drive more slowly in order not to get speed tickets, which means that they will be more able to recuperate a driving mistake. As we will not always be able to rely on this speed related measure to improve the situation, next step in France will be to come back to more alcohol-specific measures like the development of interlocks programs.

To be more accurate, there have been also alcohol-specific measures since 2000 (increase of demerit points in 2003, specific BAC of 0.02% for collective transport drivers in 2004), but these measures apparently did not impact on the general prevalence of alcohol.

Of course, this average of 30% covers important and well known discrepancies : illegal BAC's are present in 47% of fatalities in the night-time, and in 58% of the weekend nights. Lifestyles are underlying this distribution. Differences between regions may be important, with West regions more concerned (they are also the higher alcohol use regions).

Illegal BAC's are present in 24% of 0-17 years-old, 38% of 18-24 years-old, 40% of 25-44 years-old, 31% of 45-64 years-old and 8% of over 65 years-old. They are also present in 20% of severe injuries of 25-44 years-old, and in 21% of severe injuries of 18-24 years-old. So, we see that young road users are part of the problem of drunk driving, but they are not the only part of it.

The typical alcohol-related fatality is a single vehicle accident, on a small rural road, out of the crossroads.

In alcohol-related fatal accidents, 69% of the killed are the driver, 17% their passengers and 4% pedestrians hit.

Two wheels vehicles are also at risk : 37% of moped drivers and 25% of motorcycle drivers had an illegal BAC in fatalities. On the contrary, in 2011 fatalities, no truck driver and no collective transport had an illegal BAC! Cyclists are also less at risk (6%).

Gender is still a massive risk factor: 87% of illegal BAC's in casualties and 92% in fatalities are of male drivers. This constitutes a difference with Anglo-Saxon or Scandinavian countries where female drivers are more catching up with the male statistics. This may reflect the agenda of feminism, which is still less developed in the Latin countries of the South of Europe.

Alcohol offenders commit also other violations, which will increase even more the risk of fatal accidents: for example, in 11% of casualties and in 30% of fatalities, the illegal BAC drivers did not also put their seatbelt on.

The BAC's distribution was for casualties : 12% of 0.05 to 0.08, 34% of 0.08 to 0.14, 25% of 0.15 to 0.2, 24% of 0.2 to 0.3 and 4% of over 0.3. For fatalities, it was 8% of 0.05 to 0.08, 32% of 0.08 to 0.14, 24% of 0.15 to 0.2, 29% of 0.2 to 0.3 and 7% of over 0.3. So, we observe again the very high BAC's in accidents, compared to the legal limit of 0.05. This means that when people decide to violate the 0.05 limit (which we estimate around 3 unit standards for men and 2 for women), there is no limit precisely to their transgression, as these very high BAC's indicate very important consumptions!

Discussion and conclusions

So, to conclude on this statistical description, alcohol still constitutes a massive risk factor in France, especially since the speed cameras improved the speed situation here, and still represents a share of 1100 lives which could be saved.

The PERLE study

Background

We have recently launched a new study, the PERLE study, which aims at: a better understanding of the attitudes related to drinking and DUI of French teenagers; an evaluation of drunk driving preventive measures, of their impact according to the personality profiles of young people, in order to see what may improve the alcohol problem.

Methods

Methods

We have surveyed all over France 6080 subjects from 16 to 20 years-old (0,3% of the target), 57 % were girls.

Results

Boys declare to have drunk alcohol 5 times in the last month and girls 3 times. Boys declare to have smoke cannabis 3 times in the last month and girls one time. Boys declare to have done binge drinking 3 times in the last month and girls 2 times.

To the question, how many days did you binge, the answers were: 0 for 57%, 1 for 12%, 2 for 7%, 4% for 3 and 17% for 4 times or more.

30% of boys and 10% of girls acknowledged having already driven after drinking more than 3 glasses (illegal BAC). Smoking cannabis before driving was less quoted, but still by 15% of the boys. Speed and telephone violations were much more frequent (70% and 40% of boys respectively).

We asked them to estimate the riskiness of various behaviors : for example, 85% of boys and 90% of girls scored as "very risky" to smoke cannabis before driving; conversely, only 50% of boys and 60% of girls scored as "very risky" to speed over the limit. Alcohol was in intermediary position as 75% of boys and 90% of girls scored as "very risky" to drive after having drunk more than three glasses. So we have clearly here an objective for prevention: to convince 25% of the millions of young French males that drinking more than 3 glasses before driving is dangerous ! Other stakes exist as telephone use while driving was seen as dangerous by only 65% of the boys ...

Predictors of drunk driving were : compliance with peer pressure, gender and low perceived risk.

Psychological predictors like sensation seeking or impulsivity differ according to the type of traffic behavioral problem like "active" risk (drunk driving) or "passive" risk (seat-belt).

Discussion and conclusions

This survey (still on-going) shows already that binge drinking and drunk driving concern an important minority of young French males. Our future analyses will bear on the process and outcome of preventive actions directed to this target.

Random Breath Tests and Their Effectiveness Revisited. An Examination of RBT and Alcohol-Related Crash Data from 2000-2011 across Australia

Random Breath Testing in Australia: Is there an Optimum Level of Intensity?

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Abstract

Background Random Breath Testing (RBT) is the main drink driving law enforcement tool used throughout Australia. International comparative research considers Australia to have the most successful RBT program compared to other countries in terms of crash reductions (Erke, Goldenbeld, & Vaa, 2009). This success is attributed to the programs high intensity (Erke et al., 2009). Our review of the extant literature suggests that there is no research evidence that indicates an optimal level of alcohol breath testing. That is, we suggest that no research exists to guide policy regarding whether or not there is a point at which alcohol related crashes reach a point of diminishing returns as a result of either saturated or targeted RBT testing.

Aims In this paper we first provide an examination of RBTs and alcohol related crashes across Australian jurisdictions. We then address the question of whether or not an optimal level of random breath testing exists by examining the relationship between the number of RBTs conducted and the occurrence of alcohol-related crashes over time, across all Australian states.

Method To examine the association between RBT rates and alcohol related crashes and to assess whether an optimal ratio of RBT tests per licenced drivers can be determined we draw on three administrative data sources form each jurisdiction. Where possible data collected spans January 1st 2000 to September 30th 2012. The RBT administrative dataset includes the number of Random Breath Tests (RBTs) conducted per month. The traffic crash administrative dataset contains aggregated monthly count of the number of traffic crashes where an individual's recorded BAC reaches or exceeds 0.05g/ml of alcohol in blood. The licenced driver data were the monthly number of registered licenced drivers spanning January 2000 to December 2011.

Results The data highlights that the Australian story does not reflective of all States and territories. The stable RBT to licenced driver ratio in Queensland (of 1:1) suggests a stable

rate of alcohol related crash data of 5.5 per 100,000 licenced drivers. Yet, in South Australia were a relative stable rate of RBT to licenced driver ratio of 1:2 is maintained the rate of alcohol related traffic crashes is substantially less at 3.7 per 100,000. We use joinpoint regression techniques and varying regression models to fit the data and compare the different patterns between jurisdictions.

Discussion The results of this study provide an updated review and evaluation of RBTs conducted in Australia and examines the association between RBTs and alcohol related traffic crashes. We also present an evidence base to guide policy decisions for RBT operations.

Introduction

Random Breath Testing (RBT) is the main drink driving law enforcement tool used in Australia. RBT was introduced in Victoria, Australia in 1976. Over the period 1981-2006, the percentage of fatally injured motorists with a BAC .05 or more declined from almost half to just over a quarter, a reduction of 35% (Faulks, Irwin, Watson, & Sheehan, 2010). Much of this decrease in drink driving fatalities is attributed to the nationwide introduction of random breath testing (RBT) throughout Australia during the late 1970s and early 1980s (see (Harrison, Newman, Baldock, & McLean, 2003). The key elements of RBT in Australia are: legislation to implement, strong enforcement of the program with penalties, public education to raise awareness of the program and the perception that random screening is truly random and ubiquitous (Peek-Asa, 1999). Australia has strong community support for drink driving countermeasures, with nearly universal agreement for the random breath testing of drivers (Petroulias, 2011). In Australia the police have the power to pull over and breath test drivers at any time, irrespective of driving behaviour (Faulks et al., 2010).

International comparative research considers Australia to have the most successful RBT program compared to other countries in terms of crash reductions (Erke et al., 2009). This success is attributed to the programs high intensity (Erke et al., 2009). Erke et. al. (2009) conclude from their meta-analysis that testing all drivers under road block, saturation conditions is more effective than only testing those that arouse suspicion. Australian RBT programs tend to have higher intensity enforcement than other countries. For example,, unlike other countries, Australia uses ‘Booze buses’ in high visibility locations, state governments spend large amounts on publicity, and the total number of drivers tested in Australia is higher than other countries (Erke et al., 2009). Nevertheless, within Australia there has been considerable diversity in RBT program implementation: firstly in how RBT was introduced and from there how they are implemented today (see (Harrison et al., 2003; Homel, 1988; Papafotiou-Owens & Boorman, 2011).

Australia does not have a regulatory nationwide policy that dictates how many RBTs should be conducted annually. Rather, each state implements targets that vary in their degree of formality. Most Australian states and territories loosely adopt an annual RBT target equivalent to one-third of the annual number of licenced drivers within its jurisdiction which is largely based on the reviews of Homel and others. To keep police enforcement operating at high levels of visibility requires high levels of police resourcing, sustained overtime (Harrison et al., 2003). Our review of the extant literature suggests that there is no research evidence that indicates an optimal level of alcohol breath testing. That is, we suggest that no research exists to guide policy regarding whether or not there is a point at which alcohol related crashes reach a point of diminishing returns as a result of either saturated or targeted RBT testing.

In this paper we address the question of whether or not an optimal level of random breath testing exists by examining the relationship between the number of RBTs conducted and the occurrence of alcohol-related crashes over time, across all Australian states.

Methods

Our research draws on three administrative data sources to assess whether an optimal ratio of RBT tests per licenced drivers can be determined. Where possible data collected spans January 1st 2000 to September 30th 2012.

Random Breath Testing (RBT)

The RBT administrative dataset includes the number of Random Breath Tests (RBTs) conducted per month and, where available, spanning January 2000 – December 2011. With the assistance of the Queensland Police Service (QPS), police departments in each state and territory (for example Traffic Analysis Unit within the QPS) provided the data.

Alcohol-Related Traffic Crashes (ARTC)

The ARTC administrative dataset contains unit level count of the number of traffic crashes where an individual's recorded BAC reaches or exceeds 0.05g/ml of alcohol in blood for both states. Data was made available by the ARTC data custodians from each jurisdiction (in most cases this was the Police Service). Limitations in the period of data were due to administrative processes. For example in Queensland the alcohol related traffic crashes data is only available for the period spanning July 2004 to June 2009. The ARTC data was aggregated to monthly counts.

Registered Licenced Drivers

The licenced driver administrative data was provided for by appropriate data custodians in each state and territory. Most data provided were annual numbers of registered licenced drivers for the years 2000 to 2011. As monthly data were required for analysis, where annual data was provided, the monthly count of registered licenced drivers were extrapolated by interpolating monthly numbers between consecutive pairs of annual numbers. While data spanning 2000 to 2011 was requested, in some jurisdictions data for this full period was not provided.

Statistical analyses

Prior to analysis all administrative data was transformed to be monthly counts. Due to the high volume of RBTs conducted we present RBTs either as a factor of 1,000 (e.g., 310,298 would be presented as 310) or as a factor of 10,000 to simplify data presentation. As the estimated annual number of RBTs is based on a percentage (or ratio) of the annual count of licenced drivers to present to calculate monthly ratios of RBTs to licenced drivers we divide the monthly number of licenced drivers by 12 to get a ratio estimate for the number of RBTs to licenced drivers.

We first use Joinpoint Regression software (Statistical Research and Applications Branch, 2013) to evaluate and quantify any significant deviations in trends over time for each of administrative datasets. This software is data driven and uses joinpoint (or piecewise) regression as a statistical method to identify significant variations in trends within epochs. Using this approach, avoids the need to arbitrarily select a base for estimating the direction and magnitude of slopes within a data series. The software uses statistical criteria to determine when and how often the monthly percent change (MPC) across a series by fitting rates using joined log-linear segments. We specified the model to test with the maximum number of three join points within the series and allow the calculations to adjust for any auto-correlation error estimated directly from the data. Based on the number estimated line segments drawn from the analysis, each segment of the series is characterized by an MPC (Kim, Fay, Feuer, & Midthune, 2000) and the associated 95% confidence interval is indicative of the adequacy of the final model and the degree of random variation inherent in the underlying rates. In text, we have used asterisks (*) to indicate if the MPC segment is significantly different from zero. The model uses a Monte Carlo Permutation method to test if an apparent change in trend is statistically significant. A re-sampling method of 5000 iterations is specified. For further information the reader is encouraged to visit surveillance.cancer.gov/joinpoint.

All descriptive analysis and the regression analysis (and associated diagnostics) estimates where undertaken using Stata (StataCorp LP, 2011).

Results

We provide a series of graphical models contrasting the rate of RBTs per 1000 licenced drivers against the number of ARTC per 100,000 licenced drivers. As seen in Figure 1, the RBT rate in Queensland has been slightly decreasing over the past 11 years. At the turn of the millennium the RBT per licenced driver ratio was approximately 111:100 (111 RBTs per 100 registered licenced drivers) this decreased to 104:100. For the Queensland series the MPC rate was significantly different from zero (MPC: -0.086; 95% CI: -0.146--0.025). For the period where ARTC data was available the MPC rate was 0.012 (CI: -0.174-0.199) which was not significantly different from zero (or a flat line).

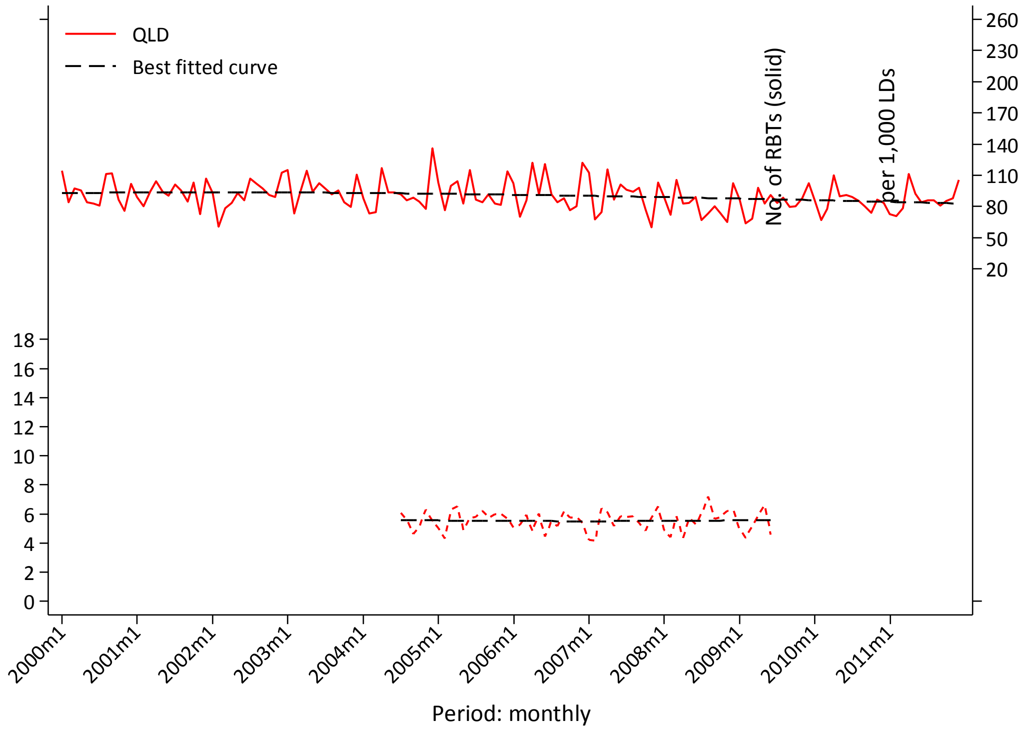

Figure 1: Queensland: Rate of ARTC (per 100,000 licenced drivers) and Rate of RBTs (per 1,000 LDs)

We use a simple OLS regression to model (see Equation 1) the effect of alcohol related traffic crashes (per 100,000 licenced drivers) after account for the number of RBTs (per 1,000 licenced drivers). The model indicated that in Queensland maintaining a RBT to licenced driver ratio of approximately 1:1 maintained a stable crash rate at 5.5 (95% CI 5.4-5.7).

Equation 1: OLS regression ARTC on RBT

$$ARTC\ per\ 10{,}000\ RBTs = \beta_0 + \beta_1 \times \left[\frac{RBTs}{Licenced\ Drivers}\right]$$

We provide a similar review of the data from other states and territories and explore ways of combining this data.

Discussion

Motor vehicle traffic crashes are a significant cost to society, both socially due to loss of life or serious injury, and financially, through economic costs, the associated burden on health systems and human capital. The introduction and use of RBT in Australia is a central and important law enforcement initiative, embraced by all states and territories since the 1980s. As both a general and specific deterrent measure against drinking and driving, international comparative research considers Australia to have the most successful RBT program compared to other countries in terms of crash reductions (Erke et al., 2009). RBT success in Australia, compared to other countries, is often attributed to its high intensity enforcement, high visibility to all drivers, large amounts of publicity (Erke et al., 2009).

Nevertheless, within Australian jurisdictions RBT program implementation and effectiveness varies considerably (Homel, 1990). This study addresses the question of whether or not an optimal level of random breath testing exists by examining the relationship between the number of RBTs conducted and the occurrence of alcohol-related crashes over time, across XX Australian states.

Our research demonstrates a strong link between the number of RBTs conducted annually and the number of alcohol-related crashes that occur where a driver's BAC reached or exceeded 0.05g/dL of alcohol in the blood. However, the direction of these links is not equal for all states and territories.

For jurisdictions such as Western Australia, Queensland, Northern Territory, New South Wales and Victoria, our research shows that after accounting for population (proxy by licenced drivers) as the number of RBTs conducted increases the number of alcohol related traffic crashes decreases; perhaps as the perceived risk of being detected is considered greater. By contrast, the story for South Australia, Australian Capital Territory, and Tasmania is reversed. In these jurisdictions, as the number of RBTs conducted increases the number of alcohol related traffic crashes also increases. The results of this study suggest that the 'Australian' model is not equal for all states and that 'state' specific characteristics may be important when developing an evidence base for policy decisions for RBT operations.

Future research

It is clear that that to increase (or potentially decrease) the number of RBTs in any state has economic concerns. For example, to double the ratio in Western Australia from 1:2 to 1:1 means doing an additional 50,000 RBTs per month. Counter to this cost though is a saving of 1.5 alcohol related crashes per month. We find a silence in the literature on the question about what is meant by a "return." For example, should a "return" on the RBT policy be measured as a reduction in the number of alcohol related traffic crashes or as marginal changes in crash reductions relative to marginal changes in costs of greater intensity? Full treatment of this issue is critical to further discussions of optimal levels of random breath testing in the future.

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An In-Depth Examination of Driver Fatalities Involving Drugs

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Abstract

Studies have established that 34% of fatally injured drivers in Canada test positive for drugs, a number that is comparable to the 38.5% that test positive for alcohol. However, unlike alcohol, where research has established specific concentrations associated with impairment (e.g., 80 mg/dL), no such equivalents have yet been established for the numerous psychoactive substances believed to affect driver behaviour. Hence, inferences about the extent of driver impairment involved and the role of drugs in the crash cannot be made with confidence. The present project was designed to help understand the involvement of drugs in motor vehicle driver fatalities.

A total of 500 coroner files from three Canadian provinces were matched with crash records and reviewed in an attempt to identify the extent to which the use of drugs (and/or alcohol) may have contributed to the crash. Attribution of the role of alcohol and/or drugs was based on evidence such as police reports of contributing factors, coroners' statements, witness statements of erratic driving or impairment, the presence of adverse environmental or vehicular factors, and evidence of alternative explanations for the crash.

Whereas the typical alcohol-related driver fatality involved a single vehicle with a male driver aged 45 to 54 leaving the road late at night on a weekend, the crashes of drug-positive drivers were more likely to involve female drivers, all age groups, and occur during daylight hours, on weekdays, and involve more than one vehicle. In 49% of cases where drugs were present, the drugs were deemed to have played a moderate or strong role in the crash. Among the cases where only alcohol was present, alcohol was deemed to be a moderate or strong factor in 96% of them. In cases where both drugs and alcohol were present, the combination of substances was deemed to be a contributing factor in 97.2% of crashes. The findings confirmed the prominent, strong influence of alcohol in fatal crashes and provided new evidence of the contributory role of drugs. The results of this study provide valuable information that has implications for prevention and enforcement.

Background

Research has established that 34% of fatally injured drivers in Canada test positive for drugs, a number comparable to the 38.5% that test positive for alcohol (Beirness, Beasley & Boase 2013). Further investigation revealed that the characteristics and circumstances of drug-involved crashes differed from those of alcohol-involved crashes (Beasley et al. 2011).

There remains a great deal to learn about the role of drugs other than alcohol in serious motor vehicle crashes. Whereas research has established a blood alcohol concentration (BAC) of 80 mg/100 dL of blood as a threshold for driver impairment by alcohol, no such levels have been determined for any other psychoactive substance. Simply stating a driver tested positive for drugs does not necessarily imply that the ingestion of the substance caused or contributed to the crash. The research presented in this reported describes the next step in understanding the role drugs play in fatal crashes.

Aims

The overall purpose of the present project was to gain greater understanding of the involvement of drugs in motor vehicle driver fatalities through an in-depth examination of crashes in which the driver was killed. In particular, the work sought to assess the evidence implicating the role played by drugs in fatal motor crashes and compare these crashes to those where alcohol was a factor.

Methods

With the cooperation and assistance of coroners/medical examiners in three provinces – Saskatchewan, British Columbia, and Nova Scotia – case files were identified and made available for review. These files contained coroner reports, autopsy reports, and toxicology reports on the results of toxicological tests for alcohol and drugs in blood samples. Where possible, these records were matched with crash records from motor vehicle departments to obtain details about the characteristics, circumstances, and police-reported factors contributing the crash. As much information as possible about the crash was collected, including the circumstances and events prior to the crash, the driving actions/behaviours immediately antecedent to the crash, and any information about the driver to determine the extent to which the use of drugs (and/or alcohol) may have compromised the ability to operate the vehicle in a safe and prudent manner. The variables collected were based on previous work on causal/contributing factors in crashes as well as those contained in the National Collision Database maintained by Transport Canada.

From the original 600 case files, a number were rejected for a variety of reasons, including: case was not a driver; the toxicology report was missing or incomplete; the case was the operator of a bicycle; the driver was under 15 years of age; or it was unclear when the driver died in relation to the time of crash. In addition, drivers who survived longer than six hours were also excluded due to the metabolism of alcohol and drugs which would be extensive during that period. Previous work has shown that 83% of drivers die within 2 hours of the crash (Beirness, Beasley & Boase, 2013). The final sample consisted of a total of 500 cases.

Provinces selected for inclusion in this study had high rates of alcohol and drug testing and were geographically diverse so as to provide a sample of cases from across Canada. It should be noted, however, that the sample of cases included in this study was neither random nor necessarily representative of all crashes in which a driver died. Only cases that were tested for both alcohol and drugs were included. The set of cases were merely intended to provide a diverse sample from which to obtain preliminary information on the contribution of drugs in driver fatalities.

Results

The 500 cases were divided into 4 groups:

- Negative – No alcohol and drugs or drugs present (n=123, 24.6%)
- Alcohol Only -- Positive for alcohol, negative for drugs (n=124, 21.6%)
- Drugs Only -- Negative for alcohol, positive for drugs (n=108, 21.6%)
- Drugs and Alcohol -- Positive for alcohol and drugs (n=145, 29.0%).

Consistent with previous research with this population (Beasley et al. 2011), whereas the typical alcohol-related driver fatality involved a single vehicle with a male driver, aged 45 to 54, leaving the road late at night on a weekend, the crashes of drug-positive drivers were more likely to involve female drivers, all age groups, and occur during daylight hours, on weekdays, and involve more than one vehicle.

Cases were reviewed by two analysts and assigned to a category reflecting the extent to which the available evidence indicated that alcohol and/or drug use by the fatally injured driver contributed to the crash. Table 1 shows the distribution of the assessed role of drugs and/or alcohol across cases in the four drug-alcohol groups.

	Negative	**Drugs Only**	**Alcohol Only**	**Drugs and Alcohol**	**Total**
No Alcohol/Drug Present	123 (100%)	--	--	--	123 (100%)
Alcohol/Drug Present – No Role	--	31 (28.7%)	5 (4.0%)	3 (2.1%)	39 (7.8%)
Minimal Role	--	24 (22.2%)	2 (1.6%)	1 (0.7%)	27 (5.4%)
Moderate Role	--	25 (23.1%)	19 (15.3%)	16 (11.0%)	60 (12.8%)
Strong Role	--	28 (25.9%)	98 (79.0%)	125 (86.2%)	251 (50.2%)
Total	123	108	124	145	500

Table 1: Distribution of the Assessed Role of Drugs and/or Alcohol According to Drug/Alcohol Group

There were 31 (28.7%) cases where drugs were detected in the analysis of bodily fluids but there was no evidence to indicate that the drug played a role in the crash. In half of these cases, another driver was deemed to be at fault. In three others, responsibility was shared between drivers. The other cases involved sudden medical conditions, road conditions, animals on the road, physical distractions within the vehicle, speed, and/or drug levels that were considered to be minimal (i.e., trace, sub-therapeutic).

In one-quarter of cases in the Drug Group, the evidence for the role of the substance(s) was considered to be strong. In these cases, the investigators noted that drug(s) were likely a causal factor, there was more than one drug present, the drug levels were considered elevated, there was evidence of recent drug use, statements/observations of erratic driving, and/or statements/observations of impaired and/or unusual behaviour. This is in contrast to the Alcohol Group where alcohol was deemed to be a contributing factor (moderate or strong) in

94.4% of cases. Among those drivers who tested positive for alcohol and drugs, these substances were deemed to be a contributing factor (moderate or strong) in 97.3% of cases.

Table 2 compares select characteristics of the set of cases in which the evidence of drug involvement was deemed moderate or strong to cases where there was minimal or no evidence of drug involvement. Cases where alcohol involvement was considered moderate or strong are included for comparison as well. There are significant differences in the cases where drugs were deemed to be a factor in the crash compared to crashes where alcohol was deemed to be a factor. Cases where drugs were deemed to be factor actually resemble those cases where either there were no drugs or alcohol present or they were not deemed to be a factor.

	Drug	**Alcohol**	**No Drug/Alcohol Involvement**	
Sex (Female)	35.8%	22.4%	26.4%	n.s
Safety Equipment Used	60.9%	44.9%	80.5%	p<.001
Speed	49.1%	66.7%	23.1%	p<.001
Single Vehicle	49.1%	82.9%	30.2%	p<.001
Crash Time 12am-6am	13.7%	32.4%	7.1%	p<.001
6am-12pm	25.5%	4.5%	31.8%	
12pm-6pm	37.3%	18.9%	39.6%	
6pm-12am	23.5%	44.1%	21.4%	
Age <19	5.7%	9.4%	11.9%	p<.001
20-24	15.1%	18.8%	11.3%	
25-34	22.6%	20.5%	9.4%	
35-44	15.1%	12.8%	11.9%	
45-54	30.2%	19.7%	14.5%	
55-64	7.5%	13.7%	17.0%	
65+	3.8%	5.1%	23.9%	

Table 2: Characteristic of Drug, Alcohol and Drugs, and Alcohol Groups

Within the Drug Group, various categories of drugs were involved, the most prevalent being Cannabis, followed by CNS Depressants, CNS Stimulants, and Narcotic Analgesics. The number of cases in each category thereby precluding statistical comparisons. However, the data suggest there are differences in crash and driver characteristics according to drug category.

Table 3 displays the strength of the evidence on the role of the contribution of drugs to crashes according to the drug category. The numbers show that cannabis and CNS stimulants are more likely to be judged to play a strong role in the crash than either narcotic analgesics or CNS depressants.

	No Role	Minimal Role	Moderate Role	Strong Role
Cannabis (THC in blood)	5.6%	0%	22.5%	71.8%
CNS Stimulants	1.6%	3.1%	17.2%	78.1%
Narcotic Analgesics	15.2%	9.7%	24.2%	51.5%
CNS Depressants	15.6%	14.3%	23.4%	46.8%

Table 3: Role of Categories of Drugs in Crashes

Discussion and Conclusions

The findings confirmed the prominent, strong influence of alcohol in fatal crashes and provided new evidence of the contributory role of drugs. There was moderate to strong evidence to suggest that the drugs played a contributory role in 49% of the cases were drivers tested positive for drugs only.

Drug-only crashes were more likely to involve female drivers and drivers of all ages. Of particular concern is that these crashes were also more likely to involve multiple vehicles compared to crashes involving alcohol. This could be an artefact of the greater likelihood of these drivers being on the road during daytime hours (6am to 6pm). In many ways, crashes where drugs were deemed to be a contributory factor resembled crashes where drivers were free of drugs and alcohol and crashes where drug were present but not deemed a factor. As a result, investigation of all crashes needs to be thorough and include tests for the presence of drugs as well as alcohol.

The fact that crashes involving drugs often occur during daylight hours on weekdays has direct implications for public education and enforcement. Drivers need to be aware of the dangers associated with driving after drug use even during the day. They need to ask their health care providers about the potential adverse effects of their medication on driving. Law enforcement needs to recognize that impaired drivers are on the road at all time of day and are not restricted to weekend nighttime hours when alcohol-involved crashes tend to be most common. Expanding enforcement activities to weekday afternoons could have direct road safety benefits.

In many of the cases reviewed, investigators seemed to be at a loss to explain why the crash occurred and often listed distraction and/or inattention as the primary causal factor. In all cases used in this study, the driver died as a result of the crash and was unable to provide any insight into the sequence of behaviours and events that led to the crash. More detailed investigations of non-fatal crashes might provide better insight into the causal factors, including the role of drugs. This could be facilitated by imbedding a behavioural analyst within the existing crash investigation teams specifically to obtain information that might help explain the sequence of events and behaviours that resulted in the crash and how these might be related to the known effects of various drugs.

With the exception of Depressants, drugs have effects that can differ dramatically from those of alcohol. It is not surprising that the role of drugs in crashes differs from that of alcohol. Further research is needed to firmly establish the causal role of drugs in crashes and the mechanism by which drugs affect various driving skills.

It should be noted that no attempt was made to gather a representative sample of driver fatalities. Rather, the approach was to gather data only from cases that were tested for both alcohol and drugs. Although overall testing rates in the selected provinces were good, there remain cases that are, for a variety of reasons, not tested. This limits the generalizability of the findings. Although the intention was to merge crash records with coroner records, there were numerous cases where a link could not be made. To some extent, this is a consequence of the fact that coroner records are victim-based, whereas motor vehicle departments maintain a crash-based system. In the absence of a common identifier, it was not always possible to match records. This also limits the ability to match different victims involved in the same crash.

The limited number of cases positive for the different drug categories precluded statistical analyses. Nevertheless, it appears that crash and driver characteristics in crashes varied according to drug category. Future research should endeavour to pursue this line of investigation with a large sample sizes. The findings could have significant implications for prevention and enforcement.

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Roadside Surveys Evaluating Immediate Roadside Suspensions for Drinking Drivers in British Columbia, Canada

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Abstract

Background
In an effort to change drinking and driving behaviour and reduce the number of serious crashes attributable to alcohol, in the spring of 2010 the Government of British Columbia, Canada announced new measures to deal with drinking drivers.

Aim
This paper presents evidence of the impact of new immediate roadside prohibitions (IRP) for drinking drivers as assessed by random roadside surveys of alcohol and drug use among nighttime drivers conducted prior to and following the introduction of IRP.

Method
Drivers were randomly selected from the traffic stream in five cities and asked to provide a breath sample to determine alcohol content and a sample of oral fluid to be tested for the presence of psychoactive drugs. The surveys were conducted between the hours of 21:00 and 03:00 on Wednesday through Saturday nights in June 2010 and again in June 2012.

Results
Driving after drinking decreased significantly following the introduction of IRP. In particular, the percentage of drivers with BACs over 80 mg/dL decreased by 59%; drivers with BACs of at least 50 mg/dL decreased by 44%. The decreases in drinking and driving were not restricted to specific sub-groups of drivers but were universal across age groups, sex, and communities. The results also revealed a changing pattern of drinking and driving. For example, the typical pattern of increased drinking and driving on weekend nights was not observed in 2012 and the prevalence of drinking drivers on the road during late night hours was less than half that found in 2010.

Discussion and conclusions
The IRP program combined immediate short-term roadside suspensions with vehicle impoundment and monetary penalties to enhance the swiftness, certainty and perceived severity of sanctions for drinking and driving. These measures were associated with a substantial reduction in the prevalence of driving with a BAC over 50 mg/dL and driving with a BAC over 80 mg/dL.

Background

Following unprecedented decreases in the magnitude of the alcohol-crash problem during the 1980s and into the 1990s, recent years have shown little change in the number of alcohol-related serious crashes. In an effort to change behaviour and reduce the number of serious crashes attributable to alcohol, in the spring of 2010 the Government of British Columbia, Canada announced new measures to deal with drinking drivers that would come into force in September 2010. These measures included an increase in the length of the immediate roadside prohibition for drivers with BACs between 50 and 80 mg/dL from 24 hours to 3 days, possible vehicle impoundment, an administrative penalty of $200, and a licence reinstatement fee of $250. The sanctions became increasingly more severe for repeat violations. Drivers found to have a BAC in excess of 80 mg/dL were subject to an immediate roadside prohibition of 90 days, 30-day vehicle impoundment, a $500 administrative penalty, a $250 licence reinstatement fee, plus enrolment in the Responsible Driver Program and the Ignition Interlock Program.[1]

Previous research has demonstrated the beneficial impact of administrative licence suspensions, largely attributed to the speed and relative certainty with which the sanctions are applied (Mann et al. 2002, Ross 1987, Voas et al. 1998). The new administrative measures introduced in British Columbia also had the essential characteristics of effective deterrence – i.e., they were applied immediately, they were applied with a high degree of certainty, and they were considerably more severe than the previous administrative prohibitions that had been in place for many years. Hence, it was anticipated that these new measures would serve to reduce the prevalence of drinking and driving.

Aims

The purpose of this study was to use roadside surveys as a means to measure the extent of change in alcohol use among nighttime drivers in five communities in British Columbia following the implementation of the Immediate Roadside Prohibition (IRP) legislation.

Methods

The roadside surveys were conducted using the same data collection procedures employed in previous surveys in British Columbia (see Beirness et al. 2010). The procedures were based on the method originally outlined by Transport Canada and updated with a few minor modifications over the years to improve the efficiency of the operation (e.g., improved breath test technology) and to provide for the optional collection of oral fluid samples to test for the presence of drugs (Boase 2012).

Drivers were randomly selected from the traffic flow at pre-selected locations in four time periods (21:00-22:30; 22:30-00:00; 00:00-01:30; and 01:30-03:00) on Wednesday, Thursday, Friday, and Saturday nights in June 2010 and June 2012. Two six-person crews carried out the survey in each of five communities. Participation in the surveys was completely voluntary. A police officer accompanied each crew to direct traffic safely off the roadway into the survey site.

For each of the two surveys (i.e., 2010 and 2012), the target was to interview approximately 500 drivers in each of five communities for a total sample size of 2,500 in each year. Assuming a simple random sample, a sample size of 2,500 would provide an estimate of the prevalence of drug or alcohol use among drivers with a 95% confidence interval of ± 1.1%.

Results

In 2010, of the 2,840 vehicles randomly selected from the traffic stream, 87% of drivers provided a breath sample. In 2012, 89.6% of 2,513 drivers selected provided a breath

[1] Details of the IRP program can be found at http://www.pssg.gov.bc.ca/osmv/shareddocs/Immediate_Roadside_Prohibition_Fact_Sheet.pdf

sample.[2] The most common reasons cited for refusing to participate were “in a hurry” (44.2%), “not interested” (23.6%), “language barrier” (11.0%), and “civil rights” (9.7%). Fear of prosecution was mentioned by only 2.2% of drivers who refused to participate.

The raw data were weighted to adjust for differences in the traffic volume at the various sites. This weighting procedure places greater emphasis on interviews from sites with higher traffic volumes. The data were also adjusted for population in each community and combined into a weighted total. This weighted total provides an estimate of the results of the survey across all five communities but should not be interpreted as a provincial estimate.

Figure 1 presents the percentage of drivers who tested positive for alcohol as well as the distribution of BAC in 2010 and 2012. In 2012, 6.5% of drivers were found to have been drinking. This represents a 34% decrease from the 9.9% of drivers who were positive for alcohol in the 2010 survey (z=4.19 p<.001). Not only was there an overall decrease in the percentage of drivers with positive BACs (χ^2=20.6, df=3, p<.001), there were decreases in every BAC group. Notable was the decrease in the percentage of drivers with a BAC over 80 mg/dL. In 2010, 2.2% of drivers had a BAC of this magnitude; in 2012, less than 1% of drivers had a BAC over 80 mg/dL -- a 59% decrease (z=3.08 p<.003).

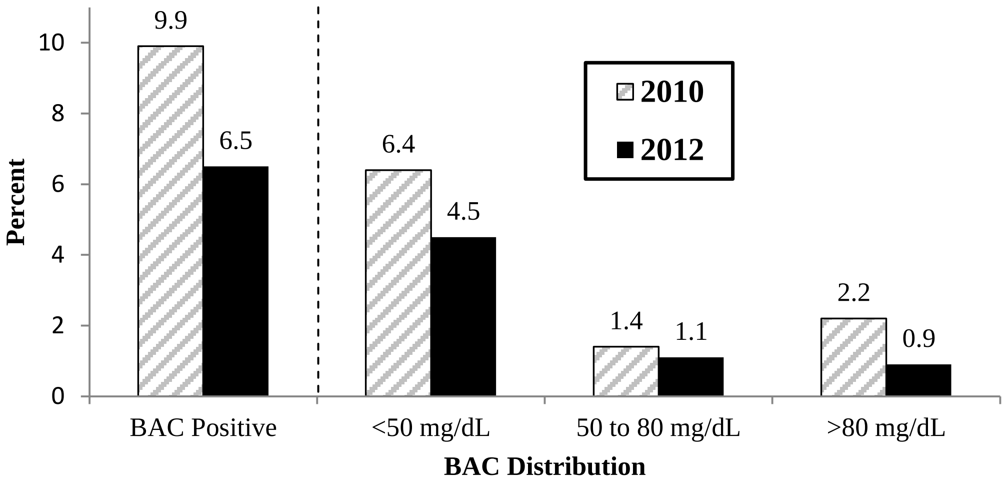

Figure 1: BAC Positive and BAC Distribution of Drivers in 2010 and 2012

In previous surveys, and as seen in 2010, the percentage of alcohol-positive drivers peaked on Friday and Saturday nights. A considerable change in this pattern was observed in 2012 with a 49.5% reduction in alcohol-positive drivers on Saturday night and a 33.9% reduction on Friday night. Figure 2 presents the percentage of drivers with BACs of 50 mg/dL and over according to survey night in 2010 and 2012. A notable change in this pattern was observed in 2012, including a 65.9% decrease in drivers with BACs of 50 mg/dL and greater on Saturday night (z=3.01, p<.01).

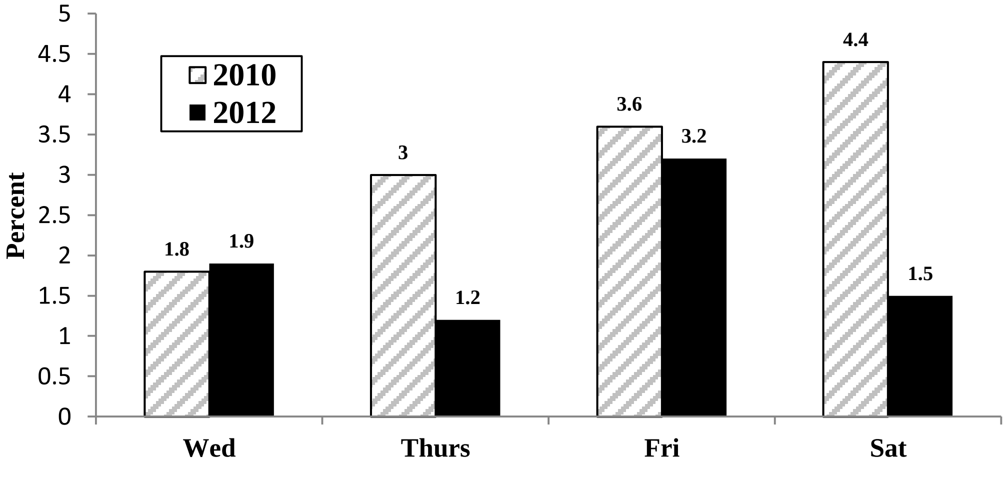

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Figure 2: Percentage of Drivers with BACs ≥ 50 mg/dL According to Survey Night

The typical pattern of an increasing percentage of drivers with a positive BAC during later survey times that was evident in 2010 was markedly reduced in 2012. Figure 3 presents the percentage of drivers with BACs over 50 mg/dL according to survey time. In 2012 there was a 49.3% reduction in drivers with a BAC of 50 mg/dL or greater between midnight and 01:30 ($z=2.05$, $p<.05$) and a 40.7% reduction between 01:30-03:00 ($z=1.49$, $p>.1$). Although the pattern of more drinking drivers at later site times was still evident in 2012, it was considerably less pronounced than in 2010.

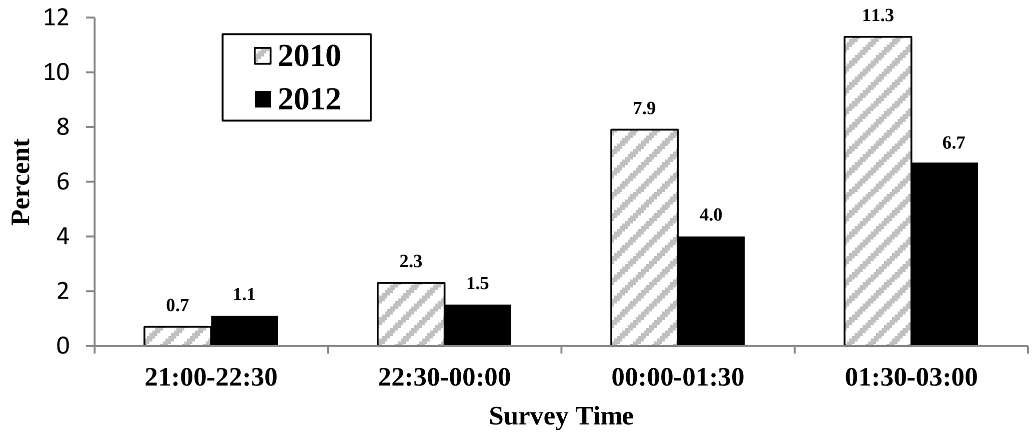

Figure 3: Percentage of Drivers with BACs ≥ 50 mg/dL According to Survey Time

Figure 4 shows the percentage of male and female drivers with BACs of 50 mg/dL and over in both 2010 and 2012. Females were just as likely as males to drive with a BAC over 50 mg/dL in both 2010 and 2012 ($p>.5$). Compared to 2010, the percentage of drivers in 2012 with a BAC of 50 mg/dL or over was 38.9% lower among males ($\chi^2=5.3$, df=1, $p<.05$) and 45.4% lower among females ($\chi^2=3.4$, df=1 $p>.07$).

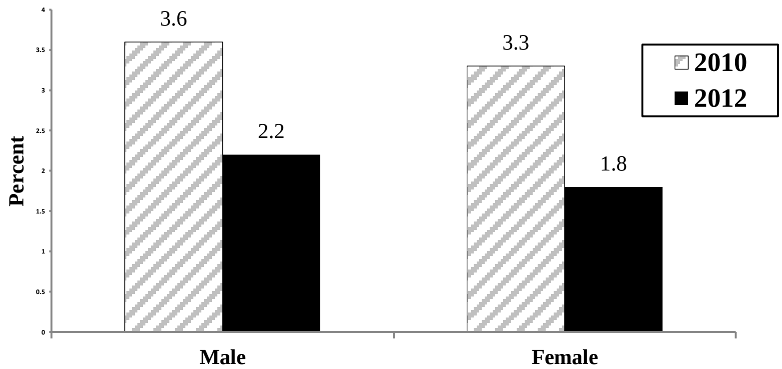

Figure 4: Percentage of Drivers with BACs > 50 mg/dL According to Sex and Year

Figure 5 presents the percentage of drivers with a BAC of 50 mg/dL or over by age group in 2010 and 2012. In 2012, there were no drivers age 16 to 18 with a BAC of 50 mg/dL or greater. Most other age groups showed a reduction in the percentage of drivers with BACs over 50 mg/dL. The largest decreases were among drivers age 25 to 34 (39.6%) ($z=1.69$, $p<.10$), and those 35 to 44 (63.2%) ($z=2.17$, $p<.05$).

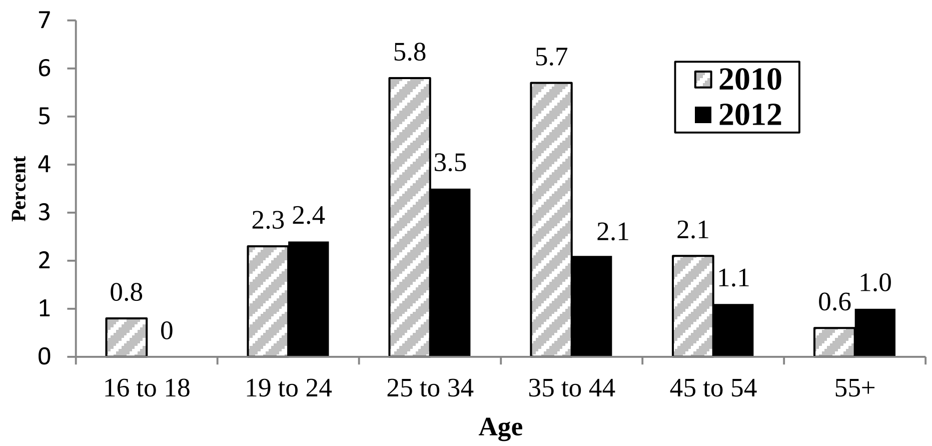

Figure 5: Percentage of Drivers with BACs > 50 mg/dL by Age

Discussion and Conclusions

The findings provide evidence of a profound change in the prevalence and pattern of drinking and driving behaviour in British Columbia following the introduction of the new immediate roadside prohibition legislation. The overall prevalence of driving after drinking, and in particular driving with a BAC over 50 mg/dL, decreased substantially following the introduction of the new IRP legislation. Driving after consuming any alcohol was reduced by 34%, driving with a BAC of 50 mg/dL or over decreased by 42% and driving with a BAC of 80 mg/dL or over was decreased by 59%.

Further analysis of the data revealed that the reductions in drinking and driving were not restricted to males or females or to specific age groups. The exception was among 19-24 year old drivers where there was no change. In addition, the temporal patterns of drinking and driving changed. The typical pattern of increased drinking and driving on weekend nights was not evident in 2012. In fact, in 2012, drinking and driving was least prevalent on Saturday night. Although driving after drinking was still most common after midnight, the percentage of drivers interviewed between 01:30 and 03:00 with BACs over 50 mg/dL was 40% lower than that found in 2010. The findings provide evidence of a profound and universal change in drinking and driving in British Columbia following the introduction of the IRP legislation in September 2010.

Administrative licence suspensions have been used for many years as an effective measure to reduce driving after drinking. Critical elements of administrative suspensions are the speed and relative certainty with which the sanctions are applied – also key factors in effective deterrence. The IRP program in British Columbia took administrative suspensions to the next level. The celerity and relative certainty of the suspension, combined with enhanced sanctions, created favourable conditions for an enhanced deterrent effect. The present results are consistent with this hypothesis.

It should be noted, however, that as compelling and persuasive as the present results are, they cannot be unambiguously attributed to the IRP legislation introduced in September 2010. The research utilized a simple pre-post design. The absence of comparable surveys in another jurisdiction that did not introduce similar legislation (i.e., a control group) leaves opens a number of threats to the validity of a causal interpretation of the documented decrease in drinking and driving. Further evidence examining data on crashes, injuries, and fatalities would help strengthen the inference that the IRP legislation was responsible for the observed changes in drinking and driving in British Columbia.

The next challenge is to sustain and strengthen the impact of the IRP legislation. In the two years between the roadside surveys, a great deal of media attention was devoted to the IRP program. The high profile of the issue served to increase public awareness of, and interest in, the issue of impaired driving. Police enforcement was intensive and many drivers experienced the sting of immediate sanctions. Although the results are encouraging, it is also evident that there remain many drivers who continue to get behind the wheel after consuming too much alcohol. Further efforts to help understand the reasons why some drivers have failed to change their behaviour will be necessary to develop new and innovative countermeasure programs specifically targeted to high risk groups. In particular, drivers age 19-24 were not impacted by the new legislation should be targeted for special measures. In the meantime, maintaining public attention along with ongoing high profile enforcement will be key elements in changing behaviour and continued success.

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Alcohol use, intentions to drink drive, perceptions of enforcement at learner licensing and drink driving as a learner and restricted licensed driver

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Abstract

Background
Alcohol-impaired driving is a particularly risky behaviour for young drivers.

Aims
To identify those at risk of being a drink driver by examining the relationship between alcohol use, drink drive intentions, and perception of drink drive enforcement among newly licensed learner drivers and their drink driving behaviour while (1) on a learner licence and (2) a restricted licence.

Method
The New Zealand Drivers Study (NZDS) is a multistage, longitudinal investigation of newly licensed car drivers and was the data source for this study. Data on alcohol use (AUDIT_C), drink drive intentions, and perception of enforcement were obtained at learner licensing (baseline) and measures of drink-drive behaviours were obtained at the NZDS follow-up interviews. At the first follow-up interview (after they passed restricted licence test) drink-driving behaviour while on a learner licence was reported. At the second follow-up interview (after they passed the full licence test) drink-driving behaviour while on a restricted licence was obtained.

Results
Multivariate logistic regression showed that, after adjusting for demographic characteristics, high alcohol use was associated with driving within two hours of drinking as a learner licensed driver (OR=3.2) and as a restricted licensed driver (OR=3.2), and also driving when thought over the legal BAC limit (OR=1.6) and when possibly unsafe to drive (OR=1.7), as a restricted licensed driver. Intention to drink-drive was associated with driving within 2 hours of drinking (OR=1.8) and high perception of enforcement was associated with driving when thought unsafe (OR=1.9), as a restricted licensed driver.

Discussion and conclusion
These results suggest that it may be possible to apply a brief alcohol screening test to identify newly licensed drivers at risk of future drink-driving. At-risk individuals could be targeted to improve their knowledge of drink-driving risk and provide them with strategies to avoid drink-driving situations.

Introduction

Alcohol-impaired driving is a risky behaviour for all drivers, and particularly for young drivers. While young drivers may not drink-drive as often as older drivers, when they do their risk of being in a fatal crash is much higher, at all blood alcohol concentrations (BACs)

(Mayhew, Donelson, Beirness et al., 1986). In New Zealand, from 2007-2011, alcohol was considered a major contributing factor in 40% of fatal crashes involving a 15-24 year old driver. The comparable rate for drivers over 25 years was 20% (Ministry of Transport, 2012b). These data show that alcohol-impaired driving remains a problem for all drivers in NZ, and particularly young drivers.

Over the past few decades, alcohol-related legislation specifically targeting young drivers in NZ has included a reduced BAC from 80 to 30mg%. This was introduced in 1987 as part of the graduated driver licensing system (GDLS) but in 1993 was applied to all drivers under 20 years of age, irrespective of licence status. In 1999, the minimum age for purchasing alcohol was lowered from 20 to 18 years, which stalled progress in reducing drink-driving, especially among females (Kypri, Voas, Langley et al., 2006). In 2011, a zero BAC limit was introduced for all drivers under 20 years (Ministry of Transport, 2012a). This change has yet to be evaluated.

Findings from research have shown that some young people over-estimate how much they can drink and still drive safely (Gulliver & Begg, 2004) and those who persistently drink and drive, when they know it is unsafe for them to do so, are more likely than others to be aggressive and alcohol dependent (Begg, Langley, & Stephenson, 2003). When alcohol use is adjusted for, drink driving behaviour can be predicted by delinquent behaviour, high risk driving, and a lower perceived risk associated with, and social support for, drink-driving (Bingham, Elliot, & Shope, 2007). These findings suggest that there are opportunities for intervention and it seems plausible that the sooner potential drink-drivers can be identified, and suitable interventions implemented, the more likely this behaviour is to be deterred.

Aims

To identify those at risk of becoming a drink driver by examining the relationship between alcohol use, drink drive intentions, and perception of drink drive enforcement among newly licensed learner drivers and their drink driving behaviour while (1) on a learner licence and (2) a restricted licence.

Method

This research was based on the New Zealand Drivers Study (NZDS) which is a prospective cohort study of 3,992 newly licensed car drivers in NZ. The interview stages of the NZDS are linked to the licensing stages of the NZ graduated driver licensing system. Data from the learner (baseline), restricted (first follow-up), and full licence (second follow-up) interviews were used in this study. The NZDS participants were recruited very soon after they had passed their learner licence test between 1st February 2006 and 31st January 2008. Full details of the recruitment procedures have been reported elsewhere (Begg, Langley, Brookland et al., 2009; Begg, Langley, Broughton et al., 2009). The restricted and full licence telephone interviews took place very soon after the study participants had passed the respective licence test. For the present study, data from the restricted licence interviews were extracted on 17 September, 2010 at which time 71% of participants had progressed to a restricted licence, 88% of whom had completed the NZDS restricted licence interview. Data from the full licence interviews were extracted on 30 May 2011 at which time 40% of the full cohort had progressed to a full licence, 93% of whom completed the full licence interview. The present analysis included those aged 15-24 years at learner licence, and who had completed the full licence interview (n=1428).

The learner licence (baseline) questionnaire included the following items: demographic and background data (gender, age, residential location, ethnicity, and deprivation); alcohol use, using the first three questions of the AUDIT (AUDIT_C) (Babor, de la Fuente, Saunders et al., 1989) which were categorised so males score of ≥4 and females ≥3 were classified as high use; and items on drink-drive intentions "How likely is it that you will drive when you have been drinking alcohol?" and perceived enforcement "In your opinion, how likely are Learner Licence holders to be stopped by the police if they drive when they have been drinking?". A response of "Not at all likely" was coded 0, and all other responses 1.

At the restricted and full licence interviews the questionnaire items included: "While on your learner licence/restricted licence, how many times did you drive a car within 2 hours of drinking at least one alcoholic drink?"; "On how many occasions do you think you were over the legal alcohol limit for you to drive?"; "On how many occasions do you think that you had too much to drink to be able to drive safely?" The responses were coded 0 and >0.

The first stage of the analysis involved running cross tabulations for each of the baseline measures (alcohol use, intention to drink-drive, perception of being caught) by the drink-drive behaviours (within 2 hours, over BAC limit, unsafe to drive) as a learner licensed and restricted licensed driver. Chi-square and Fisher's Exact Tests (when numbers were small) were used to determine significant relationships. Multivariate logistic regression models, with backwards selection, were run for each of the response variables that had adequate numbers for analysis. Models were adjusted for age, gender, ethnicity, deprivation, and residential location.

Results

The results from first stage of the analysis are presented in Table 1. At the learner licence stage, of the 323 (272 + 51) reporting high alcohol use, 16% (n=51) had driven within two hours of drinking. Of these 51 drink-drivers, 41% (n=21) had driven when they thought they were over the legal BAC limit, and 14% (n=7) when it was thought unsafe for them to drive. The comparable figures for those who were not high alcohol users were: 6%, 38% and 12%. High alcohol use was significantly associated with driving within 2 hours of drinking (p<.0001) but not when thought to be over the BAC limit or when unsafe to drive. Intention to drink drive was significantly associated with driving within 2 hours of drinking (p=.0025) but not driving when they thought over the BAC limit or when unsafe. Perception of police enforcement was not significantly associated with any of the three drink drive behaviours.

At the restricted licence stage, of the 345 who reported high alcohol use 155 (45%) had driven within two hours of drinking, 98 (63%) of whom had driven when they thought they were over the legal BAC limit, and 57 (37%) when it was unsafe for them to drive. The comparable figures for those who were not high alcohol users were 22%, 54%, and 23%. High alcohol use was significantly associated with driving within 2 hours of drinking (p<.0001) and when it was unsafe to drive (p=.004) but not when they thought they might be over the BAC limit (p=.087). Those who reported intentions of drink-driving were more likely to report driving within 2 hours of drinking (p<.0001), but not when they thought they were over the legal BAC limit or when it was unsafe to drive. Perception of police enforcement was not significantly associated with any of the three drink drive behaviours.

The results from the multivariate logistic regression analysis, after backward selection, are presented in Table 2. At the learner licence stage the only outcome with sufficient numbers for analysis was "driving within 2 hours of drinking". High alcohol use was significantly

Table 1
Cross tabulations of the baseline alcohol measures and drink-drive behaviours reported at the learner licence and restricted licence stages

	Learner Licence Drink-Driving Behaviours					
Baseline measures	Within 2 hours		*Over BAC limit		*Unsafe to drive	
High alcohol use	No	Yes	No	Yes	No	Yes
No	917 (94%)	60 (6%)	37 (62%)	23 (38%)	53 (88%)	7 (12%)
Yes	272 (84%)	51 (16%)	30 (59%)	21 (41%)	44 (86%)	7 (14%)
Intention to drink-drive						
No	989 (93%)	79 (7%)	46 (58%)	33 (42%)	67 (84%)	12 (15%)
Yes	214 (87%)	33 (13%)	21 (64%)	12 (37%)	31 (94%)	2 (6%)
High perception of being caught						
No	308 (90%)	33 (10%)	20 (61%)	13 (40%)	29 (88%)	4 (12%)
Yes	894 (92%)	79 (8%)	47 (59%)	32 (41%)	69 (87%)	10 (13%)

	Restricted Licence Drink-Driving Behaviours					
	Within 2 hours		Over BAC limit		Unsafe to drive	
High alcohol use	No	Yes	No	Yes	No	Yes
No	810 (78%)	227 (22%)	103 (46%)	123 (54%)	174 (77%)	53 (23%)
Yes	190 (55%)	155 (45%)	57 (37%)	98 (63%)	98 (63%)	57 (37%)
Intention to drink-drive						
No	855 (76%)	275 (24%)	120 (43%)	155 (56%)	193 (70%)	82 (30%)
Yes	158 (59%)	110 (41%)	44 (40%)	65 (60%)	79 (72%)	31 (28%)
High perception of being caught						
No	261 (73%)	99 (28%)	47 (47%)	52 (53%)	77 (78%)	22 (22%)
Yes	752 (73%)	284 (27%)	117 (41%)	166 (59%)	195 (69%)	89 (31%)

* only includes those who had reported driving within 2 hours of drinking
Note: missing values are not included in the tables

associated with driving within 2 hours of drinking at the learner licence (OR 3.2) and restricted licence stages (OR 3.2) and when they thought they were over the BAC limit (OR 1.6) and when it possibly unsafe to drive (OR 1.6), at the restricted licence stage. In addition, intention to drink-drive was associated with driving within 2 hours of drinking at the restricted licence stage (OR 1.8), and high perception of being caught by police was associated with driving after drinking when it was perhaps unsafe to drive (OR 1.9).

Table 2
Final results* from multivariate logistic regression, using backward selection, examining high alcohol use, intention to drink-drive, perception of being caught by police and drink-drive behaviours as a learner licensed and restricted licensed driver

Learner Licence Stage	Drive within 2 hours of drinking			
	Odds Ratio	95% CI**		p-value
High alcohol use	3.2	2.2	4.9	<.0001
Restricted Licence Stage	Drive within 2 hours of drinking			
High alcohol use	3.2	2.4	4.2	<.0001
Intention to drink-drive	1.8	1.3	2.4	.0002
	Drive when thought over BAC limit			
High alcohol use	1.6	1.0	2.6	.04
	Drive when perhaps unsafe			
High alcohol use	1.7	1.1	2.7	.03
High perception of enforcement	1.9	1.1	3.3	.03

*All results adjusted for age at learner licence, gender, residential location, deprivation, ethnicity ** Confidence Interval

Discussion and conclusion

The results from this study showed that drink-driving behaviour by young, newly licensed 15-24 year old drivers, was strongly associated with high alcohol use measured very soon after they had passed their learner licence (theory test). High alcohol use was associated with each of the outcomes examined, driving within two hours of drinking alcohol at both the learner and restricted licence stages, and driving when they thought they may be over the legal BAC limit, and driving when thought that it was perhaps unsafe to drive, at the restricted licence stage. Alcohol use was measured using the AUDIT_C which is the first three alcohol consumption questions of the AUDIT (Babor, de la Fuente, Saunders et al., 1989). The AUDIT_C has been shown to be an effective brief screening test with other populations (Bush, Kivlahan, McDonell et al., 1998) so could be an effective way of identifying young potential drink-drivers before they commence their licensed driving careers.

Nine percent of all the learner licensed drivers reported driving within two hours of drinking alcohol, and of them 40% thought they might be over the legal BAC limit, but only 13% thought it was perhaps unsafe for them to drive. This suggests that some of these young learner licensed drivers were driving when they were possibly over the legal limit for them (30mg% for <20 years old, and 80mg% for 20-24 year olds) yet still thought it was safe for them to drive. At the learner licence stage all drivers are required by law to be supervised by an experienced, fully licensed driver. However, we do not know if these drivers were supervised at the time they were drink-driving, but we do know that unsupervised driving is not uncommon among learner licensed drivers (Langley, Begg, Samaranayaka et al., Under consideration). Enforcing the supervision requirement, and ensuring the supervisor is sober (which at present is not a legal requirement in NZ) may help eliminate drink-driving by these very inexperienced, young learner drivers.

At the restricted licence stage (when unsupervised driving is allowed except between 10pm and 5am, or with passengers) the prevalence of drink-driving was much higher than at the learner licence stage. Driving within two hours of drinking alcohol was reported by 28% of the drivers, 58% of whom thought they may be over the legal BAC limit but only 26% thought it was perhaps unsafe for them to drive. These young people do not appear to understand the risks associated with driving after drinking alcohol. This may help explain why alcohol is a contributing factor in 40% of traffic crash deaths involving 15-24 year olds in NZ. The introduction, and enforcement, of a zero BAC for all drivers under 20 years may possibly help to bring about the necessary change in this behaviour, and extending it to 20-24 year olds may need to be considered if their high alcohol-related crash rate persists.

These results suggest that it may be possible to apply a brief alcohol screening test to identify newly licensed drivers at risk of future drink-driving. At-risk individuals could be targeted to improve their knowledge of drink-driving risk and provide them with strategies to avoid drink-driving situations.

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A Comparison of Drug Use by Fatally Injured Drivers and Drivers at Risk

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Abstract

Research has documented the prevalence of drug use among drivers involved in serious crashes. Although the overrepresentation of alcohol among drivers involved in serious crashes has been repeatedly demonstrated in numerous studies, relatively few studies have attempted to determine the magnitude of the risks posed by drivers who have used drugs. The purpose of this study was to examine the extent to which drugs may present a risk to road safety by comparing the prevalence of drug use among drivers at risk and drivers who die in motor vehicle crashes.

Data on alcohol and drug use from coroners' and medical examiners' files on drivers of motor vehicles who died in crashes were compared with data on drug use among drivers who participated in roadside surveys in British Columbia, Canada conducted between 2008 and 2012 as a means to help establish the contributory role of drugs in driver fatalities. The results show increased probability of fatal crash associated with the use of alcohol or drugs and greatly increased risks associated with the use of alcohol and drugs in combination. Alcohol remains a primary substance of concern for road safety. Cannabis also presents increased risks for drivers as does the combined use of cannabis and alcohol. These findings will contribute to program and policy initiatives to improve road safety.

Background

The recent surge in interest in the issue of drugs and driving has prompted numerous experimental studies to determine the degree of impairment associated with drug use as well as epidemiological studies to determine the extent of drivers' use of psychoactive substances. But descriptive epidemiological studies can only determine the prevalence of drug involvement among drivers. Analytic epidemiological studies are required to establish whether, and to what extent, drivers who have used drugs are at increased risk of crash involvement.

The general approach is to use a case-control design or conduct a responsibility/culpability analysis to compare the incidence of drug use in a control population of drivers at risk with the incidence of drug use in a population of cases – i.e., drivers involved in, or responsible for, a crash. The extent to which drugs are more frequently detected in the population of cases provides an indication of the degree of risk posed by driver drug use. These types of studies have been instrumental in understanding the risks associated with various levels of alcohol use by drivers (e.g., Bloomberg et al. 2009; Borkenstein et al. 1964).

A number of studies have examined the possible overrepresentation of drugs in serious crashes. A recent review of these studies (Beirness, Logan and Swann 2010) revealed a wide range of findings, with some studies showing significantly increased risks for some substances and some showing no increase in risk. To some extent, the differences in findings could be attributed to the wide variety of approaches used along with differences in samples sizes, response rates, sample medium, and analytical methods. Consequently, the studies provide mixed evidence on the risks associated with drug use by drivers. These studies do, however, provide consistent evidence on the increased risks associated with the use of a combination of alcohol and drugs that exceeds the risks of using either one alone.

Aims

The purpose of the present study was to compare the alcohol and drug use among fatally injured drivers with that among drivers who participated in random roadside surveys in British Columbia to determine the extent to which drug use might be overrepresented among driver fatalities.

Method

A population level case-control analysis was conducted using data on drivers that died in crashes in road crashes British Columbia during the years 2006 through 2010 (cases) and data from roadside surveys conducted in British Columbia in 2008, 2010, and 2012 (controls).

Data on fatally injured drivers in British Columbia were extracted from the national fatality database, which includes the results of toxicological tests for drugs and alcohol. A total of 902 fatally injured drivers of highway vehicles, 16 years of age and over, who died within 6 hours of crash involvement and were tested for both alcohol and drugs were included. These cases were divided into four groups according to drug and alcohol use: Alcohol and Drug Negative (n=339, 35.9%), Drugs only (n=188, 19.9%,), Alcohol only (n=187, 19.8%), and Alcohol and Drugs (n=188, 19.9%).

The roadside surveys were conducted by randomly selecting drivers from the traffic flow at pre-selected locations in four time periods (21:00-22:30; 22:30-00:00; 00:00-01:30; and 01:30-03:00) on Wednesday, Thursday, Friday, and Saturday nights in June 2008, 2010, and 2012. Drivers were asked to voluntarily provide a sample of breath and oral fluid for analysis of alcohol and drug content. Further details of the procedure can be found elsewhere (Beirness and Beasley 2010).

A total of 6,884 vehicles were randomly selected from the traffic flow for participation in the three roadside surveys. Among the vehicles selected, 88.2% of drivers provided a breath sample and 72.1% provided an oral fluid sample. There were 4,711 drivers that provided both an oral fluid sample and a breath sample. These drivers were divided into four groups according to drug and alcohol use: Alcohol and Drug Negative (n=3928, 83.4%), Drugs only (n=382, 8.1%,), Alcohol only (n=320, 6.8%), and Alcohol and Drugs (n=81, 1.7%).

Results

Table 1 presents the numbers of drivers in the case and control samples for various subgroups of alcohol and/or drug positive drivers along with odds ratios and 95% confidence intervals calculated using the alcohol- and drug-negative drivers as the comparison.

Table 1: Odds Ratios Comparing Alcohol and Drug Cases with Controls

	N Controls (Roadside)	N Cases (Fatalities)	Odds Ratio (95% Confidence Interval)
No Alcohol/Drugs (Comparison)	3928	339	1.0
Alcohol Only	320	187	6.77 (5.47-8.38)
Drugs Only	382	188	5.70 (4.63-7.02)
Alcohol+Drug	81	188	26.89 (20.2 – 35.7)
Alcohol <80 mg/dL	239	29	1.41 (0.94 – 2.10)
Alcohol >80 mg/dL	81	158	22.6 (16.9 – 30.2)
Cannabis	178	76	4.95 (3.70 – 6.62)
Cannabis + Alcohol	32	111	40.1 (26.7 – 60.4)
Alcohol Positive Male	224	148	7.66 (6.04 – 9.70)
Alcohol Positive Female	93	39	4.86 (3.29 – 7.18)
Alcohol Positive Age 16-24	75	47	7.26 (4.96 – 10.6)
25-40	135	64	5.49 (4.00 – 7.55)
41-55	73	47	7.46 (5.09 – 10.9)
56+	33	29	10.1 (6.11 – 16.98)
Drug Positive Male	291	135	5.38 (4.26 – 6.78)
Drug Positive Female	89	53	6.90 (4.83 – 9.87)
Drug PositiveAge 16-24	116	27	2.70 (1.75 – 4.16)
25-40	137	47	3.98 (2.8 – 5.64)
41-55	94	64	7.89 (5.64 – 11.04)
56+	32	50	18.1 (11.46 – 28.6)

The odds ratios indicate the odds of drivers who have used alcohol and/or drugs dying in a crash compared to the odds of a fatality occurring to drivers who have used neither alcohol nor drugs. Odds ratios that do not include the value 1.0 are deemed to be statistically significant.

As might be expected, drivers who had consumed alcohol were over 6 times more likely to die in a crash than drivers who had used neither drugs nor alcohol. Drivers with blood alcohol concentrations (BACs) of 80 mg/dL or less were 40% more likely than drivers free of alcohol or drugs to die in a crash but the increase was not statistically significant. The odds of drivers with BACs in excess of 80 mg/dL were 22 times higher than alcohol and drug free drivers to die in a crash.

Overall, driver drug use was associated with a 5.7 times greater likelihood of dying in a crash. Combining drugs with alcohol, and particularly alcohol in excess of 80 mg/dL, greatly increased the odds of drivers dying in a crash. The use of alcohol and drugs increased crash odds for both men and women and all age groups.

A separate analysis was conducted to specifically examine driver cannabis use. As shown in Table 1, cannabis use increased the odds of dying in a crash by a factor of close to 5. Using cannabis with alcohol increased the odds by 40 times.

Discussion

These results add to the body of evidence showing the increased risk associated with driving after using drugs, alcohol, and a combination of drugs and alcohol. The present study used two separate datasets in a population case-control analysis to assess the odds of drivers dying in a road crash following the use of alcohol and/or drugs. Alcohol and drug use were associated with a higher likelihood of fatal crash involvement. Combining alcohol and drug use further increased the odds of fatal crash. These relationships held for both males and females and all age groups. Isolating cannabis use among drivers in both populations also showed increased odds of fatal crash involvement, especially when combined with alcohol.

The approach used in this study is similar to that used by other researchers to assess the extent of risks posed by the use of alcohol and drugs by drivers (Dussault et al. 2002; Mayhew et al.). However, this approach is not definitive and has several limitations that must be considered in attempts to generalize the findings and use them to inform policy. The control population was a relatively large sample of drivers randomly selected from the traffic stream in selected cities in British Columbia during the month of June in 2008, 2010, and 2012. Although there were high rates of compliance with the request for breath and oral fluid samples to assess alcohol and drug use, respectively, there remains suspicion about the alcohol and drug use of those who refused. The municipalities selected for inclusion in the roadside survey included a large proportion of the population of drivers in British Columbia but were not deemed to be representative of the entire population. The roadside surveys were conducted in the month of June, which was deliberately selected to take advantage of generally favourable weather conditions and to avoid tourist seasons and holidays. The surveys were also restricted to Wednesday through Saturday nights between the hours of 2100 and 0300. This reflected the original survey plan that was designed to sample drivers at times known to be associated with drinking.

An effort was made to match the sample of fatally injured drivers to the roadside survey sample in terms of time of night, vehicle types, and years. Compromises had to be made to ensure sufficient cases for analysis. The fatality data for 2012 (and 2011) were not yet available so it was necessary to include data from 2006 and 2007 to provide a sufficiently long period to obtain an adequate sample of cases. Fatalities from all months of the year were also included. Cases were only included if they died within six hours of the crash and were tested for both alcohol and drugs. Over 86% of fatalities succumbed to their injuries with this period and 95% of these cases were tested for alcohol and 90% were tested for drugs. The 6-hour inclusion criterion may seem too long. Indeed, it is sufficiently long to allow lower alcohol and drug levels to fall below detectable thresholds. However, this criterion has been employed for many years and was preserved for this analysis. Any bias introduced by this criterion is conservative in that it would produce a lower number of cases found to be positive for alcohol and/or drugs.

Case-control studies of alcohol and drug use by drivers are logistically challenging to conduct and require a great deal of time and resources as well as considerable cooperation among road safety professionals, enforcement, and government officials. The present approach provides a means to begin to assess the risks associated with driving after using alcohol and drugs. Further studies with much larger sample sizes and a better match between cases and controls are required to provide the public and policy-makers with the best available information about the role of drugs in road safety. Demonstrating the increased risk of crash involvement associated with drug use, combined with information on the impairing effects of various types of drugs, provides enforcement, policy-makers and prevention specialists with the knowledge required to advocate for change and create programs and policies and procedures to help make the roads safer for all.

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Drug Use Among Fatally Injured Drivers in Canada

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Abstract

Over the past several decades, information provided by coroners and medical examiners on the use of alcohol by drivers who die in motor vehicle crashes has been instrumental in monitoring the extent of the problem, evaluating the impact of programs and policies and generally furthering our understanding of the magnitude and characteristics of the alcohol-crash problem . In the same way, comparable information on the use of drugs by fatally injured drivers is critical in furthering our efforts to reduce the number of serious crashes in which psychoactive drugs are involved. The purpose of this study was to examine the results of toxicological tests performed on fatally injured drivers of motor vehicles in Canada to determine the extent and type of drug use as well as the characteristics of the people and the circumstances involved.

Data on alcohol and drug use from coroners' and medical examiners' files on drivers of motor vehicles who died in crashes from 2000 through 2010 in Canada. Psychoactive substances were grouped according to the system used by the Drug Evaluation and Classification program. Among drivers who died within six hours of the crash, 96% were tested for alcohol and 58.8% were tested for drugs. Of those tested, 33.7% were positive for a psychoactive drug; 38.5% were positive for alcohol. Overall, 56.7% of fatally injured drivers were positive for alcohol, drugs, or both. The most commonly detected substances were central nervous system depressants and cannabis. The present findings provide greater understanding of the involvement of drugs in serious crashes, revealing differences in the characteristics of drivers and crashes involving alcohol versus drugs that have implications for prevention and enforcement.

Background

In Canada, data from various sources have begun to shed light on the prevalence of driving after drug use. Self-report data from the Canadian Addiction Survey show that 4.8% of drivers in Canada admitted driving within two hours of using cannabis at least once in the past (Beirness & Davis 2007). In 2008, a roadside survey of alcohol and drug use among drivers in British Columbia found 10.4% of drivers tested positive for drugs; 8.1% were found to have been drinking (Beirness & Beasley 2010). In a study of drivers treated at a trauma centre in Toronto for injuries sustained in a serious crash found 41% tested positive for drugs and 35% were positive for alcohol (Stoduto et al. 1993). In a study of selected driver fatalities in British Columbia, Mercer and Jeffery (1995) reported that drugs were detected in about one-third of cases. Recent and more comprehensive data are required to better understand the magnitude and characteristics of drug-involved crashes.

Aims

The primary purpose of the present study was to examine data on the results of toxicological tests on bodily fluid samples collected by coroners/medical examiners from fatally injured drivers in Canada to provide an estimate of the prevalence of drug use by drivers killed in road crashes. A secondary purpose was to examine and compare the characteristics and crash circumstances of drug-positive drivers with those of drivers who tested positive for alcohol.

Method

For over three decades, data on alcohol use by persons who die in motor vehicle crashes in Canada have been collected from coroners'/medical examiners' files and compiled in a national database (TIRF 2011). In 2000, the database was expanded to include the results of toxicological tests for drugs other than alcohol but these data are not included in the annual report of the national database.

The present study was restricted to fatally injured "drivers' – i.e., those persons deemed to be operating or in control of the vehicle – and who died and/or were tested for the presence of alcohol and/or drugs within 6 hours of the crash.

An initial review of the data suggested that drivers are sometimes tested for a wide variety of drugs, including many substances not known to have psychotropic properties and unlikely to cause driving impairment (e.g., acetaminophen, statins). Therefore, as an initial step, all substances listed in the database were recoded into categories corresponding to those used by the Drug Evaluation and Classification (DEC) program—Central Nervous System (CNS) depressants, inhalants, dissociative anaesthetics, cannabis, CNS stimulants, hallucinogens, and narcotic analgesics (IACP 1999).

Of the 20,485 drivers who died during the 11-year period from 2000 – 2010, 16,227 met these criteria for inclusion – 15,570 (96.0%) were tested for alcohol and 9,547 (58.8%) were tested for drugs. The 9,530 cases that were tested for *both* alcohol and drugs were divided into four groups according to drug and alcohol use: Alcohol and Drug Negative (n=339, 35.9%), Drugs only (n=188, 19.9%,), Alcohol only (n=187, 19.8%), and Alcohol plus Drugs (n=188, 19.9%).

Results

Despite an increase in drug testing rates over the years, the percentage of drivers that test positive for drugs has remained relatively constant over the last nine years, ranging from 29.7% in 2000 to 36.7% in 2008. Similarly, the percent of drivers that tested positive for alcohol has shown no substantive or sustained change, ranging from 36.2% in 2002 to 41.1% in 2009. Central Nervous System (CNS) depressants and cannabis were the most frequently detected substances followed by CNS stimulants and narcotic analgesics. Hallucinogens, dissociative anesthetics and inhalants were rarely detected.

Characteristics of the Drivers

To examine the characteristics of drivers and crashes, the analysis focusses on fatally injured drivers in the Alcohol only and Drugs only groups – i.e., those that tested positive for only alcohol or only drugs.

Males account for 80% of the fatally injured drivers and compromise 87.6% of all alcohol-positive cases and 83% of all drug positive cases. Figure 1 displays the percentage of male and female drivers Alcohol only and Drugs only groups. (The Alcohol plus Drug group and the No Alcohol or Drug group are not shown.) Males are more likely (24.6%) than females (15.5%) to test positive for alcohol (χ^2= 58.9, df=1, p <.0001) yet there is no significant difference in the proportion of males (33.9%) and females (31.4%) that test positive for drugs (χ^2= 0.36, df=1, p>.05). Females were more likely to test positive for drugs than alcohol (Z = 2.76, p <.01) whereas males are more likely to test positive for alcohol than drugs (Z= 5.91, p <.001). The type of drug also varied by driver sex. Whereas females were most likely to test positive for depressants and opiates, males were most likely to test positive for cannabis and stimulants.

Figure 1: Percentage of Male and Female Drivers Testing Positive for Alcohol and Drugs

Figure 2 presents the percentage of Alcohol only and Drug only cases according to age group. (The Alcohol plus Drug group and the No Alcohol or Drug group are not shown.) The extent of alcohol and drug use varied considerably among age groups (χ=661, df=18, p<.001). Alcohol was more prominent than drugs in many age groups, particularly those age 19 to 24 and 25 to 34. Of note, however, is that among drivers 18 years of age and under and those 55 years of age and over, drug use was more prevalent than alcohol.

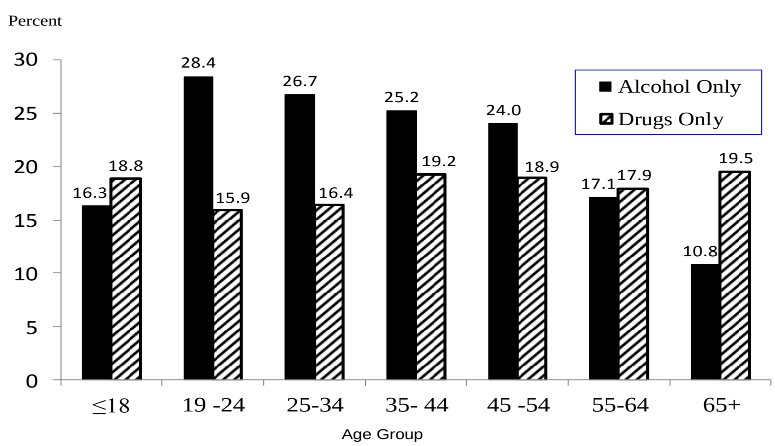

Figure 2: Drug and Alcohol Positive Driver Fatalities According to Age

Characteristics of the Crash

Figure 3 shows the percentage of fatally injured drivers in the Alcohol only and Drug only groups according to the day of the crash. There were significant differences in the percentage of alcohol positive drivers according to day of the week on which the crash occurred (χ^2=403, df = 18, p < .001). Alcohol was considerably more prevalent on weekends (Friday, Saturday, Sunday) than on weekdays. Drug use among fatally injured drivers was actually less common on weekends than weekdays. Although not shown in the figure, the Alcohol plus Drugs group showed a pattern similar to alcohol alone.

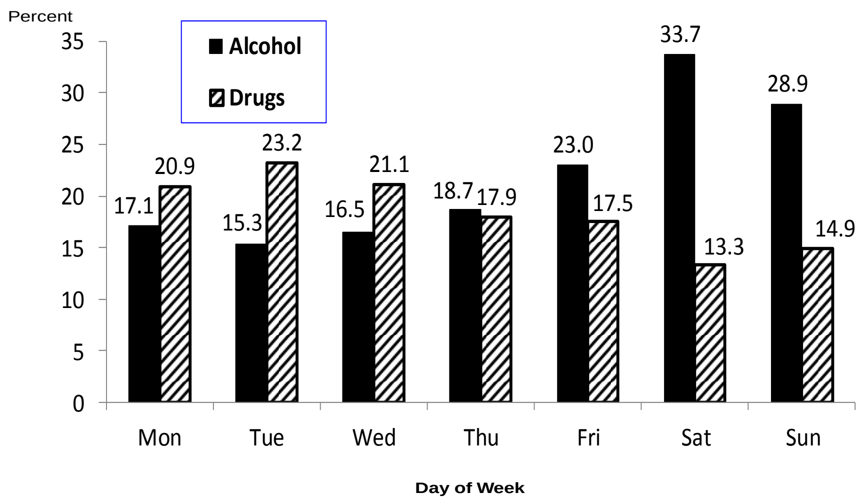

Figure 3: Percentage of Driver Fatalities Positive for Drugs or Alcohol According to Day of Week

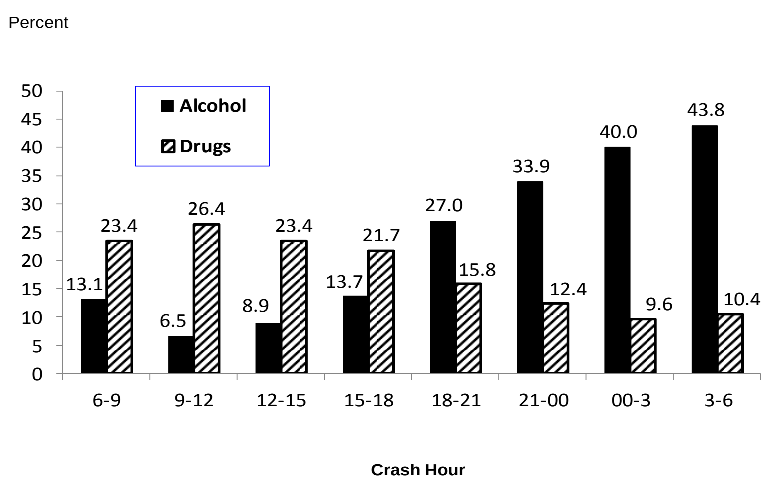

Figure 4: Percentage of Driver Fatalities Positive for Drugs or Alcohol According to Time of Crash

Figure 4 displays the percentage of driver fatalities that tested positive for alcohol or drugs according the time of the crash. Once again, there were substantial differences in the pattern of alcohol- compared to drug-involved fatalities (χ^2=1892, df=21, p<.001). Whereas alcohol-involved driver fatalities were most prominent during late night hours, drug-involved fatalities were most prevalent during daytime hours.

Discussion and Conclusions

The prevalence of drug use among fatally injured drivers is at a level comparable to that of alcohol. Central nervous system depressants and cannabis were the most frequently detected drug categories, followed by central nervous system stimulants and narcotic analgesics. These types of substances are known to have psychoactive properties that can impair the ability to operate a vehicle safely. But whereas research has established thresholds for alcohol above which it can be confidently presumed that the driver was impaired, the same cannot be said of most drugs. Hence, the mere presence of the substance does not necessarily mean the driver was impaired. Further research is required to help understand the relationship between drug dose and various types of behavioural and cognitive impairments relevant to driving.

Despite similar rates of drug and alcohol involvement among driver fatalities, the data indicate that the characteristics of drivers who test positive for drug use differ from drivers who test positive for alcohol use. Alcohol was more frequently involved in young among male driver fatalities whereas drug use was more frequently detected among female drivers. Males were also more likely than females to test positive for a combination of alcohol and drugs. The types of substances used by males and females also differed.

The temporal characteristics of alcohol- and drug-involved fatalities differed as well. Alcohol consumption tends to be a late-night weekend activity and the involvement of alcohol in driver fatalities reflects this phenomenon. Driver fatalities that were positive for drugs were more evenly distributed throughout all times of the day. Unlike alcohol, males and females were equally likely to test positive for psychoactive drugs.

In Canada, testing for alcohol among drivers who die in motor vehicle crashes has become commonplace, with 96% of fatally injured drivers who die within 6 hours of the crash having been tested for the presence and amount of alcohol. Over the past three decades these data have been an important surveillance tool, providing a valuable source of information on the magnitude of the alcohol-crash problem and have been instrumental in assessing changes in the problem over time. These data have also been utilized extensively in evaluating the impact of legislation and countermeasures in reducing the extent of the problem.

Since 2000, toxicological tests for drugs have been included in the national fatality database. The testing rate for drugs, however, lags considerably behind that for alcohol. Several jurisdictions have increased their rate of testing for drugs over the past few years, providing a better—but still incomplete—picture of drug use among fatally injured drivers. Many factors are at work in determining which drivers get tested for drugs and which drugs are included in the testing protocol. Greater consistency in drug testing rates and drug testing procedures across jurisdictions would enhance the validity of the estimates of drug use derived from this database.

There remains a great deal to learn about driving after drug use. Although driving after drinking and driving after drug use appear to be related issues, the data suggest that they represent distinct social and behavioural phenomena. Drugs and driving is a more complex issue than drinking and driving and requires further research to understand the risks involved for different substances and different populations of drivers. Moreover, whereas the patterns of alcohol use and the resultant crashes are relatively predictable, the patterns of drug use and drug-involved crashes may vary by type of substance. This creates a very complex situation for prevention and enforcement. Hence, it cannot be assumed that the same techniques, policies, procedures and countermeasures that were developed and utilized effectively to combat drinking and driving can be readily adapted or transferred to deal with the drugs and driving issue. This highlights the need to develop unique prevention and enforcement strategies specific to the use of drugs by drivers.

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Effect of alprazolam (0.5 mg) on driving performance of anxiety patients and healthy controls

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Abstract

Background
Alprazolam is a widely prescribed anxiolytic for the treatment of anxiety, panic disorder, and depression. Current literature suggests that alprazolam impairs driving performance (e.g. Verster et al., 2002; Vermeeren et al., 2009).
Aims
In the present study the major objective was to investigate the effect of alprazolam in treated and untreated anxiety patients compared to a healthy control group after oral alprazolam administration (0.5 mg) (acute phase) in a simulated environment. Primary variables were the vehicle variables (driving performance measures). The secondary objective was to compare multiple cognitive and subjective measures collected for each participant in order to establish the whole range of driving impairment.
Methods
In this study, the alprazolam effect (0.5 mg) on drivin performance was investigated in three experimental groups: a) treated anxiety patients, b) untreated anxiety patients, and c) control group. 51 (38.2 ±10.5 years old) participants completed two driving tasks; a lane tracking and a car following scenario with a semi-dynamic passenger car simulator. Impaired weaving control was observed in all groups after alprazolam administration. Increase in brake reaction time (sec) was found in treated and untreated anxiety patients when driving in the car following scenario. Healthy participants showed riskier close following behaviour after alprazolam administration compared to treated and untreated anxiety patients ($p<.001$). A significant decrease in alertness -measured in computerised attention tests -was found only in healthy participants ($p=.015$). Untreated patients and healthy participants reported decreased vigilance.
Discussion and conclusions
This study clearly showed an alprazolam effect (0.5mg) in driving performance in treated, untreated anxiety patients and healthy participants.

Introduction

Alprazolam (Generic Xanax®) is a benzodiazepine derivative mainly prescribed for the treatment of generalised anxiety, panic disorder, and depression. It is the most often prescribed psychoactive substance (Verster et al., 2002). The usual clinical dosages of alprazolam, administrated in divided doses, range from 0.5 mg to 4 mg/day for the treatment of anxiety disorder and from 6 to 10 mg/day for the treatment of panic disorders. Reported adverse effects after alprazolam intake include sleepiness, sedation, drowsiness, and reduced alertness.

Current studies advocate that alprazolam might have detrimental effects on driving performance. Verster and colleagues (2002) investigated the acute effects of alprazolam (1mg) on driving performance during real traffic in conjunction with laboratory tests related to driving skills. Statistically significant differences were found between the alprazolam and placebo groups with regards to Standard Deviation of Lateral Position (SDLP), Standard Deviation of Speed (SDS) accompanied by impairment in laboratory tests. Vermeeren and colleagues (2009) reviewed related literature on axiolytics' effect on driving. Their discussion on over-the-road driving points out that the mean increase of SDLP in this study was comparable to BAC=1.5mg/ml (Louwerens et al., 1987). Subjective assessment showed also impairment in driving quality, decrease in alertness, lower mental activation, and increased mental effort. Verster and colleagues (2005) carried out a literature review on 14 placebo controlled and double blind studies which investigated the effects of anxiolytic drugs on on-the road tests. Standard Deviation of Lateral Position (SDLP) was the main driving parameter. They concluded that among other types of benzodiazepines a single dose of alprazolam might impaired driving performance (i.e. increased weaving was recorded). The authors suggested patients treated with alprazolam should be cautioned when driving a car and that it might not be safe to drive while under alprazolam therapy.

In general, relevant studies have shown detrimental impairment due to alprazolam administration on driving performance (e.g. Snyder et al., 2005), controlled laboratory settings (e.g. Seppala et al., 1986) and subjective scales (Vermeeren et al. 2009).

Methods

This section describes the participants' demographics and the sample selection process.

Participants

In total, 51 participants (38.2 ±10.5 years old) were recruited in the experiment. The following table presents age and gender distribution for each group.

Table 1: Group characteristics

Group	**Age (Mean±SD)**	**Gender (M/F)**
Treated **(Group A; N=15)**	42.4±13.9	8/7
Untreated **(Group B; N=18)**	36.9±8.9	9/9
Control **(Group C; N=18)**	35.4±8.8	8/10

All participants were screened prior participation and were medically examined by two collaborating doctors. Correct medical diagnosis was ensured by the collaborating doctors. In the patients groups (Groups A and B), the participants were diagnosed with anxiety and, specifically, with a Hamilton Anxiety Rating Scale equal or greater than 20 (HAM-A: mild to moderate severity) (Hamilton, 1959). Patients in Group A were systematically using alprazolam for at least 2 months before the testing day. Patients in Group B did not receive any kind of treatment for at least two months before the testing day. Participants in Group C had no medical history of anxiety or alcohol abuse and were free of medication. Participants were experienced drivers and were currently active drivers. Volunteers received reimbursement for their participation.

Study design
The present study utilises a mixed design for the comparison of patient and control experimental groups in question. The independent variable was the alprazolam administration with two levels: (baseline and alprazolam 0.5 mg intake). Dependent variables were: a) the driving performance (simulated environment), b) attentional performance (computerised tests in winTAP), and c) subjective assessments. The aim was to investigate the acute effect of alprazolam administration (0.5mg) and the potential of additive effects (treated) in two driving tasks.

Procedure
At arrival participants completed a driving background questionnaire and written consent was obtained after detailed briefing. Both alcohol screening (with breathanalyser) and urine drug screening were performed before testing takes place. Participants had a familiarisation drive in order to get used to the driving simulator. Participants had to complete two tasks at the driving simulator (Figure 1); a lane tracking scenario for about 20 minutes in a highway environment maintaining a constant speed of 90 km/h and a car following scenario for about 20 minutes in a highway environment maintaining a safe distance from the lead vehicle that was moving with a steady speed of 90 km/h. Four instances of abrupt breaking (leading vehicle) occurred randomly. Participants received instructions for each driving scenario. For the lane tracking scenario participants were instructed to maintain steady lateral position. For the car following scenario they were instructed to maintain a safety distance from the lead vehicle. Scenarios were counter-balanced between the two phases and among participants.

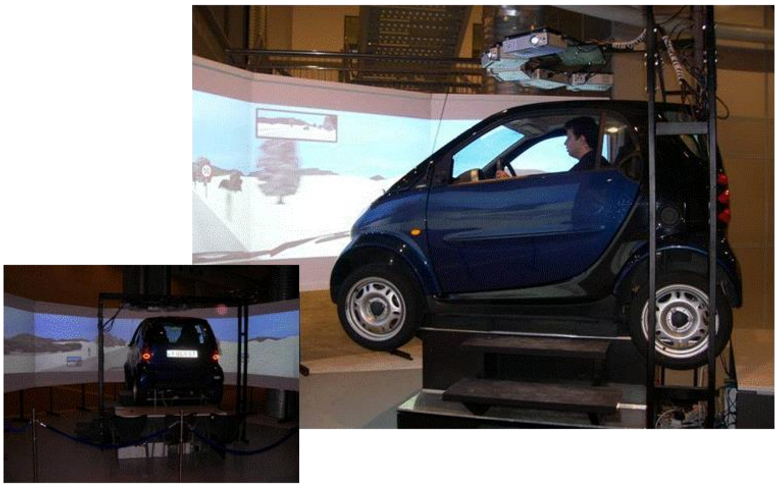

Figure 1: Passenger car driving simulator

Following the simulator driving scenarios, participants completed a computerised alertness choice test (winTAP, Zimmerman and Fimm, 1993) and reaction times (msec), omissions and errors were recorded. Sleepiness was subjectively rated before and after each driving scenario and before and after the computerised tests. Higher scoring meant less vigilance and subsequently increased sleepiness [The Karolinska Sleepiness Scale (KSS) is a universally accepted, validated and standardised scale (Åkerstedt and Gillberg, 1990)].

Blood collection lasted approximately 10-15 minutes and usually participants wanted to relax and take a small break before the driving tasks. Participants started the driving tasks almost 15 minutes after blood collection (10 ml tubes of whole blood, serum and blood spot specimens) and about an hour after alprazolam intake. The time interval between administration and driving was adequate before testing takes place and was based on relevant studies (e.g. Leufkens et al., 2007).

Statistics
Within and between participants comparisons were carried out with repeated measures of General Lineral Models (GLM) and one-way ANOVAs. In case of violation of homogeneity and homoscedacity assumptions, non-parametric equivalents were administered (Friedman and Wilcoxon rank test, respectively). The α level was set at .05. Statistical analyses were performed with the statistical programme Statistical Package for the Social Sciences (SPSS) (version 18.0 for Windows; SPSS, Chicago, IL).

Results

Alprazolam intake impaired driving performance in all groups. In particular, increased weaving (SDLP= 5.8 cm) has been found in treated anxiety patients when driving an hour after alprazolam intake (F (1, 14) =11.31, p=.005). Similarly, untreated anxiety patients showed a significant increase of 4 cm after alprazolam intake (F (1, 17) =5.28, p=.035). On the same track, healthy participants showed the greatest increase in weaving (ΔSDLP=6.8 cm; F (1, 17) =36.34, p<.001).
The following bar charts (Figure 2) present the percentages (%) of impaired/improved driving performance as a function of alprazolam serum concentration levels (ng/mL). It appears that alprazolam is associated with impairment in lateral position keeping even in low concentrations in treated patients (100% ; <5) and controls (80%; <5).

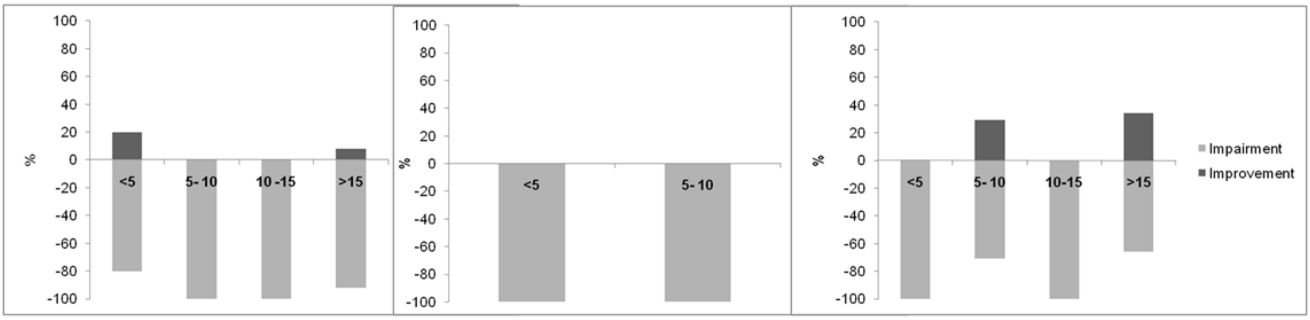

Figure 2: Percentage of impairment/improvement as a function of serum concentration (ng/mL) for the control, untreated, and treated groups (from left to right)

For the untreated anxiety patients only two concentration levels (<5 and 5-10 ng/mL) were detected and impairment with regards to lateral position keeping was observed. Increased impairment was noted in the treated anxiety group for the serum concentration groups of 5-10 and >15 ng/mL. For the other two groups, almost in all cases impairment was observed. Therefore, impairment is present even in small concentrations regardless of group type (i.e. presence of anxiety disorder or not).

Significant increase in brake reaction time was observed in treated (0.5 sec; p<.05) and untreated patient groups (1 sec; p<.05) but not in the control group (0.3 sec) in the car following scenario. The attention test revealed significant decrease in alertness (mean difference: 31.92 msec) only in the control group (p=.015) after alprazolam intake. Untreated patients felt significantly less vigilant in the alprazolam condition (p=.001). Similarly, healthy participants felt significantly less vigilant after alprazolam intake (p=.018).

Discussion

The findings of this study support the main hypothesis that alprazolam will impair driving performance in all three groups. Indeed significant increase in weaving (SDLP) was found in all groups after alprazolam administration. Specifically, alprazolam's detrimental effects were evident in weaving in all groups with higher lateral deviation in the control group by more than 6 cm. Therefore vehicle lateral control is affected by alprazolam intake. Relevant literature is in agreement with these findings. Alprazolam intake deteriorates lateral control but acute effect (Curran, 1986; Leufjkens et al., 2007) is greater than chronic administration due to tolerance in the sedating effects because of repeated use as it seems to be the case with lateral deviation in the treated anxiety patients' group in this study. Likewise, most alprazolam studies have found high increments of SDLP. Verster and colleagues (2002) observed increments of SDLP of approximately 9 cm.

However, lane deviations in real traffic deviate from corresponding measurements in a simulated environment. Thus ramification and extrapolation of results should be made with this difference taken into consideration. Respective between groups' comparisons showed no significant differences among groups after alprazolam oral administration ($p<.05$). Therefore impairment may be comparable among groups as the difference among groups was approximately around 2-2.5 cm. Only in treated patients' group a percentage of improvement was observed. The other two groups had almost solely impaired weaving. This improvement may depict (overall ≈20% improvement) tolerance. Non-sedative antidepressants were found not to affect SDLP values (Ramaekers, 2003). Furthermore, alprazolam affected brake reaction time in treated and untreated anxiety patients. As treated group showed the greatest overall deterioration in reaction time (0.95±0.24 sec), additive effect of alprazolam intake may be greater than acute for reaction time (untreated: 0.9±0.02; control: 0.83±.03). Serum concentrations revealed that impairment is present in all groups even in small concentrations and, thus, leading to the conclusion the effect might be present regardless the concentration. However, the size of the effect for each concentration level might be important for defining the level of impairment.

It appears that additive effects are more powerful and treated anxiety patients do not show tolerance effects in psychomotor tests or psychomotor related driving skills, without of course, isolating them from the rest of parameters. Subjective assessments of treated anxiety patients are in favour of the tolerance proposition as there was no significant difference in their evaluation of sleepiness during driving scenarios in the simulated tasks. On the contrary, untreated and healthy participants reported increased sleepiness after alprazolam administration which reflects their driving performance. It is important to keep in mind, though, that anxiety patients are overly self-conscious, pay high self-attention after the activity, or have high performance standards for themselves. It should be borne in mind that anxiety patients' subjective assessments of their driving behaviour may be influenced also by their symptomatology.

Alprazolam significantly affected alertness in the control group but no other significant impairment was observed for the neuropsychological tests. Relevant studies have found differences. The greater effect was the acute effect in healthy individuals. It is important to note that this battery is standardised to driving behaviour but has not been applied in drug related research before. Subjective scales confirmed the effect perceived by participants. Treated patients did not perceive any difference in vigilance. On the contrary, the other two groups-not used in alprazolam medication-reported that they felt significantly less vigilant (untreated and control) and that they drove badly (untreated). It is alarming that treated patients did not report any difference or change in the way they drive which might imply that their everyday driving performance is affected and they may not be aware of it and their risk of accidents due to lack of awareness may be increased.

The effect of alprazolam in healthy participants was stronger than in treated and untreated patients. Alprazolam intake (0.5 mg) might improve the driving performance of anxiety patients but might have deteriorative effect in healthy controls' driving performance. This study clearly showed an alprazolam effect (0.5mg) in driving performance in treated, untreated anxiety patients and healthy participants. Conclusively, the main findings of this study are in agreement with current research that people under alprazolam medication should be informed about the potential detrimental effects of alprazolam administration to their everyday activities and driving. Likewise, physicians and medical practitioners should be educated and trained on how the adverse effects of alprazolam prescriptions may affect driving performance.

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Comparison of driving performance in treated and untreated Obstructive Sleep Apnoea Syndrome (OSAS) patients and healthy controls

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Abstract

Background

Obstructive Sleep Apnoea Syndrome (OSAS) has been shown to be an increased risk factor for traffic accidents. Studies performed in driving simulators have reported improvements in driving performance with the application of Continuous Positive Airway Pressure (CPAP) treatment.

Aims

This study aims to investigate the effect of OSAS to driving behaviour and the comparison to driving under the influence of alcohol.

Methods

In the present study, 18 OSAS patients were treated with CPAP treatment for 7 consecutive days. A second group of healthy participants (N=18) was included in the study with a baseline and an alcohol consumption condition (BAC=0.50 g/l). All participants drove two scenarios in a simulated environment; a lane tracking and a car following scenario.

Results

No improvement due to CPAP treatment was found (p>.05) in weaving control (SDLP) for the lane tracking scenario. On the contrary, statistically significant impairment was found in SDLP due to alcohol (p=.027). Percentage (%) of time spent driven with low Time-to-Collision (TTC) values was calculated. Treated OSAS patients spent significantly more time with safe keeping distance than untreated patients (p<.001). Likewise, intoxicated participants spent significantly less time driving with safe distance from lead vehicle in car following scenario (p=.008). Equivalence in impairment level was found for Brake Reaction Time (BRT) (sec) for the car following scenario between OSAS and alcohol.

Discussion and conclusions

In conclusion, the effect of sleep apnoea appears to be detrimental compared to the alcohol effect at the legal limit. The application of intermediate alcohol BAC levels (i.e. 0.02, 0.08., 0.1) could provide insight in finding comparable levels of impairment. The difference in mean SDLP values in OSAS patients seems to be almost double the difference induced by alcohol consumption at BAC=1.2 (5.3 cm; Verster & Raemekers, 2009). Probably higher levels of alcohol levels are necessary to be included in a future research effort for the chosen types of driving parameters in order to perform comparisons of effects in driving fitness due to Obstructive Sleep Apnoea Syndrome.

Introduction

A large number of subjective (i.e. self-report) and objective (e.g., insurance or police records) studies have looked at the prevalence of Motor Vehicle Accidents (MVAs) for patients suffering from Obstructive Sleep Apnoea Syndrome (OSAS) as compared to the general population (e.g., George, 1996; Maycock, 1996; Wu & Yan-Go, 1996). The majority of these studies have suggested that OSAS presents an increased risk factor for MVAs.

Results from these studies have shown that patients with OSAS have an increased accident rate in driving simulation tests (e.g. Findley et al., 1995; George, Boudreau, & Smiley, 1996; Juniper et al., 2000), estimated to be around two to seven-times higher compared to healthy participants (e.g. George, 2004). It has also been reported that OSAS patients exhibit slower reaction times than controls in road obstacle avoidance, resulting in four times more object collisions than normals (Findley et al., 1989). In addition, it has been demonstrated that OSAS patients perform poorer than controls in steering ability (referred to as "tracking error"; George et al., 1996; Juniper et al., 2000), with half of the patients being worse than any one control participant, and with some patients showing worse performance than healthy controls under the influence of alcohol (George et al., 1996). Finally, research conducted to-date have concluded that the OSAS patients face an increased difficulty in sustaining attention while driving, thus exhibiting poorer performance and lower vigilance during experimental testing when driving on a monotonous highway route (e.g. George, Boudreau, & Smiley, 1996; Juniper et al., 2000; Turkington et al., 2001).

Given that driving is an essential part of everyday life for the majority of people, a series of treatments have been developed, in order to assist OSAS patients in driving and other daily activities. Continuous Positive Airway Pressure (CPAP) represents the most commonly used treatment and it is considered to be the most effective one (Cassel et al., 1996; Yamamoto et al., 2000). Studies have shown that CPAP treatment can reduce the number of accidents in patients with OSAS, both in simulated driving (Findley et al., 1989) and in real-life situations (e.g. Cassel et al., 1996; Findley et al., 2000; George, Boudreau, & Smiley, 1997; Yamamoto et al., 2000). Specifically, studies have shown that regular use of CPAP improves self-reported (Cassel et al., 1996; Yamamoto et al., 2000) and objective MVA rates (Findley et al. 2000; George, 2001). Relevant studies have shown that CPAP treatment may effectively reduce the MVA risk of OSAS patients in experimental tests conducted in a simulated driving setting (e.g. Engleman et al., 1994; Note, however, that the task utilised in some of these studies was actually a choice reaction task that required sustained vigilance rather than a simulated driving task).

Alcohol remains the greatest documented risk factor in driving performance and the literature is vast on alcohol effects on fitness to drive. Alcohol is the only substance affecting driving behaviour that legal limits apply. Alcohol-impaired driving is a major cause of serious and fatal car accidents. The relative crash rate for a driver with a BAC of 1.5 g/l is about 22, but drivers' relative crash rate for fatal crashes with that amount of alcohol in their blood is about 200 (Simpson & Mayhew, 1991). Individual differences play a sizeable role in the elimination of alcohol from the human organism. Difference in accident risks is, also, an outcome of causation. Alcohol is classified as a depressant, due to its effects to the central nervous system (CNS). Existing diversity in findings across studies leads to no consensus on the effects on driving impairment in performance by a given amount of alcohol (34% of studies report impairment by .05%). Current research techniques have revealed deterioration in driving performance at lower BAC levels. However, Moskowitz and Robinson (1987) reported in their review that impairment was recorded in psychomotor tasks at a level of 0.07%. In addition, simple reaction time score (RT) was found to be an unreliable and insensitive measure. On the contrary, tracking and divided attention tasks were shown to be impaired at much lower levels (0.01-0.02%). In most studies deterioration is present above 0.08%.

Methods

Participants
Eighteen OSAS patients (17 male/1 female; 51.9±11.54 years old) and 18 healthy controls (14 male/4 female; 45.5±16.4 years old) with Body Mass Index (BMI) 33.4±7.13 kg/m^2 26.26±3.25 kg/m^2, respectively matched for driving experience volunteered in this study. Participants received reimbursement for their participation. Inclusion criteria for sleep apnoea patients OSAS was based on a diagnosis of an Apnoea-Hypopnoea Index (AHI) ≥10 (after a polysomnographic study). Participants in both groups were active and experienced drivers. Written informed consent was obtained from all participants before enrolment and after briefing.

Procedure
Untreated OSAS patients were tested and then re-tested after having used the CPAP treatment continuously for at least 7 days. The healthy group was tested in two conditions, with zero BAC level and with BAC 0.5g/l, which is the legal limit for driving in Greece. The level of alcohol had to be sustained throughout the experiment; hence breathanalysis was performed prior and post driving scenarios and in-between neuropsychological tasks. Participants had to complete a lane tracking scenario on a highway environment maintaining a constant speed of 90 km/h (20 minutes) and a car following scenario maintaining a safe distance from the lead vehicle that was moving with a steady speed of 90 km/h. The vehicle ahead would brake abruptly suddenly and unexpectantly during the scenario.

Statistical analysis
Within and between participants comparisons were carried out with repeated measures ANOVAs and one-way ANOVAs. In case of violation of homogeneity and homoscedacity assumptions, non-parametric equivalents were administered (Friedman and Wilcoxon rank test, respectively). Within comparisons were carried out in order to investigate the effect of CPAP treatment and alcohol. Between comparisons were carried out in order to investigate the relationship between OSAS and alcohol in driving impairment. The α level was set at .05. Statistical analyses were carried out with SPSS 18.0 for Windows (SPSS 18.0, Chicago, IL.).

Results

OSAS patients showed more deteriorated performance in lane keeping (SDLP) than any other condition. CPAP treatment did not seem to significantly improve lane keeping behaviour, although decreased swerving was recorded. Figure 1 depicts mean SDLP (m) values per condition. As shown below, OSAS patients showed lower lateral control before CPAP treatment. After treatment, lateral control increases but not significantly ($p>.05$). However, the tracking control is still impaired compared to suggested thresholds (Brookhuis et al., 2003) and when compared to the control group before (F (1,34) = 10.57, $p<.001$)** and after alcohol consumption (F (1,34) = 8.23, $p<.001$)***. In addition, intoxicated control group weaving was greater compared to the no alcohol condition (F (1,17) = 5.9, $p=.027$)*. Alcohol had an effect on participants' lateral control but the magnitude was not as great as the sleep apnoea's effect on OSAS patients****. Untreated OSAS patients spent significantly more time (6.81±0.57% of time) driving with low TTC values (between 0 and 1 sec) which is extremely risky (F (1,17) = 5.46, p = .032) compared to the CPAP treated condition (6.37±0.54% of time). Similarly, participants from the control group (6.35±0.44% of time) spent significantly more time with low TTC values (between 0 and 1 sec) when compared to the alcohol consumption condition (5.7±0.36% of time) (F(1,17) = 4.27, p = .054). Between groups' comparisons were not significant (p>.05).

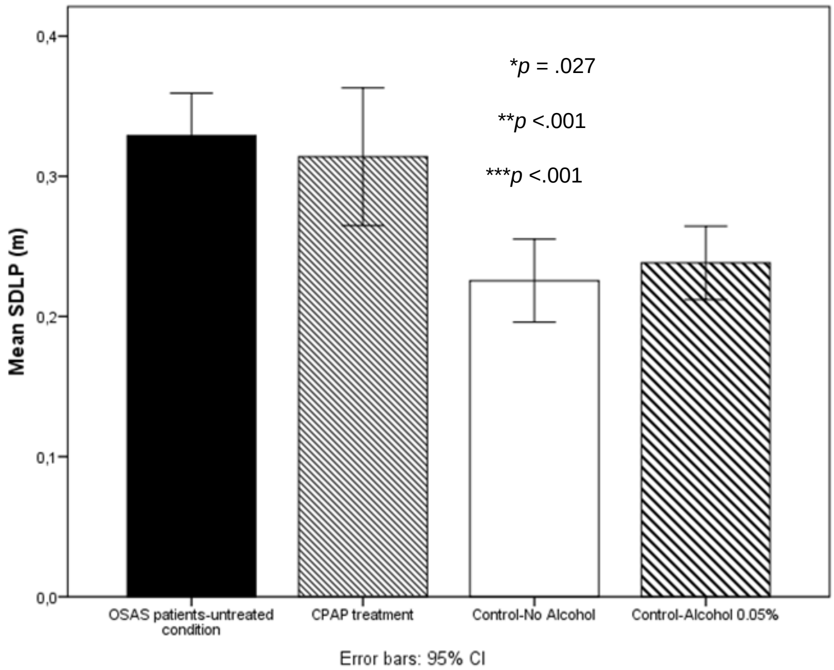

Figure 1: Mean SDLP (m) values per condition in lane tracking scenario

Almost all comparisons were statistically significant (Figure 1) except the comparison between the treated OSAS group and the alcohol group (p>.05). Treated OSAS patients spent significantly more time driving with TTC values between 2 and 4 seconds (i.e. safe car following driving style) before treatment (3% more time, F(1,17) = 18.05, p = .001). Likewise, participants in the control group spent more time (approx. 2.5%) with safe car following style than the intoxicated group (F(1,17) = 8.93, p = .008). Untreated OSAS patients spent more time than the control group with safe car following distance (F(1,34) = 11.42, p = .002). This TTC category is strongly connected to safety distance keeping; hence the significant difference among groups could reflect risk taking behaviour. The control group spent significantly more time (3%) than the treated OSAS patients in car following (F(1,34) = 4.49, p =.041). On the other hand, no statistically significant differences between the OSAS treated group and the alcohol group (p>.05) were found. Similarly, no significant difference were found between the alcohol and the untreated OSAS patients groups (p = .066; trend). Greater braking reaction times (sec) were recorded for the untreated OSAS patients and the lowest reaction times (sec) were recorded for the CPAP treated patients (F (1,17)=12.37, p =.003). Moreover, it seems that alcohol did not have an impact in braking reaction time for the alcohol group (p>.05) at the legal limit. On the contrary, participants from the control group reacted much faster when they were sober compared to the untreated OSAS patients (F (1,17)=6.55, p=.015).

Discussion and conclusions

The main findings demonstrated that sleep apnoea affects driving performance. Continuous Positive Airway Pressure (CPAP) treatment did not seem to improve significantly driving performance. Furthermore, the present experiment suggests that alcohol consumption at legal BAC might impair driving performance; however deterioration is less when compared to sleep apnoea. The difference in mean SDLP in OSAS patients seems to be almost double the difference induced by alcohol consumption at BAC=1.2 (5.3 cm; Verster & Raemekers, 2009). Equivalence might be present for brake reaction time (sec) between sleep apnoea and alcohol effect. The present study showed that sleepiness and hypo-vigilance induced by sleep apnoea may be an increasingly contributing factor in road accidents which are sometimes overlooked in driving research focusing mainly on alcohol and illicit drugs. In the present experiment, OSAS patients showed almost one third more weaving than the control group participants (31.5%). Other studies have shown significant improvement in driving behaviour as a result of using the nasal CPAP for different periods of time. For instance, Loredo and colleagues (1999) found improvement in CPAP treatment after 7 days. The same treatment period was used in this study based on Loredo et al.'s (1999) findings. The differences were not found in the quality of sleep (sleep architecture) and, thus, changes in this type of sleep may be influential in order to find improvement in driving variables such as the ones measured in this experiment (SDLP, %TTC, and BRT). In other words, the period of treatment time may not suffice in order to reveal improvement in driving behaviour when the driving task is performed in a monotonous simulated environment with these specific vehicle parameters. In addition, the monotonous environment may be the most "dangerous" choice or the most "accident-evoking" but it is far from realistic and induces sleepiness beyond control which reflects probably the worse-case scenario and not necessarily the most frequent situation. The percentage (%) of time spent driving within certain categories of TTC values has not been investigated in the literature before, thus, it is difficult to examine the TTC results under the prism of research-to-date and to step forward towards any generalisable inferences. Decrease in number of crashes, as mentioned above, might be associated with the significant decrease in driving time with TTC values lower than 2 seconds (p=.032). Therefore, the accident risk might be reduced. Driving impairment due to alcohol consumption, even for the legal national limit (0.5g/l), is evident in both lane and car following scenarios. One of the main objectives was to investigate the relation of sleep apnoea effect and alcohol in specific driving variables. Inferences should be conservative and differences were not found for brake reaction time (sec). This finding suggests that braking delay might be similar for sleep apnoea patients and intoxicated participants (alcohol consumption at legal limit). Brake reaction time (BRT) is the time to respond to sudden changes in the driving environment by fully depressing a brake pedal. Previous research has identified possible risk factors associated with delayed brake reaction time, such as alcohol use (Kuypers et al., 2006) and medications causing sedation such as antihistamines or psychotropic agents (Vuurman et al., 2004). brake Brake reaction time could be influenced by factors like gender and age Therefore, by controlling these factors, it might be possible to reveal effects. Overall, it seems that the effect of sleep apnoea is detrimental compared to the alcohol effect at legal limit. Probably higher levels of alcohol are required in order to reveal any equivalence to OSAS for the chosen types of driving parameters.

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The Role of Injunctive Norms in Alcohol Misuse and Drink/Driving

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Abstract

BACKGROUND: The Theory of Normative Social Behavior (Rimal, Real, 2005) hypothesizes that the association between descriptive norms and outcome behaviors is moderated by injunctive norms and outcome expectations. Injunctive norms are the individual's perceptions of how they are expected to behave by important others (e.g., parents, friends). Outcome expectations are anticipated costs and benefits associated with the outcome behavior. AIMS: To examine descriptive and injunctive normative influences on alcohol misuse and drink/driving. We hypothesized that descriptive norms would predict alcohol misuse and drink/driving, and that this association would be reduced when accounting for injunctive norms and outcome expectations. METHODS: The sample for this study was 5,464 (49% male), mostly white, US young adults, age 24 years, participating in a longitudinal study of alcohol use and driving, who were interviewed by telephone. Multiple linear regression models were estimated separately by sex. RESULTS: In models predicting alcohol misuse, after adjusting for demographics (i.e., marital status, race, income, parenthood), individuals who perceived their similar-aged peers to use alcohol (both sexes) were more likely to misuse alcohol. These associations were reduced, but remained significant when best friends' and parents' attitudes toward drinking and drink/driving, and risk-taking propensity and perceived likelihood of negative consequences of drink/driving (e.g., arrest, injury) were entered into the model (R^2 men=0.42, women=0.38). Adjusting for demographics, similar-aged peers' drinking (both sexes) predicted drink/driving. Prediction by these variables was reduced when injunctive norms (parents' and friends' attitudes toward drinking and drink/driving) were accounted for, and when outcome expectations and alcohol misuse were introduced into the model (R^2 men and women=0.47). CONCLUSIONS: These results suggest that interventions should focus on weakening the influence of descriptive norms on alcohol misuse and drink/driving, while strengthening injunctive norms and outcome expectations that are not supportive of alcohol use and drink/driving.

Background

Alcohol-impaired driving (i.e., driving with a BAC > 0.08g/dL) in the US resulted in 9,878 fatalities and accounted for 31% of all traffic fatalities in 2011. Those killed included 6,507 impaired drivers, 1,612 passengers of impaired drivers, 1,049 occupants of other vehicles, and 710 non-occupants. The majority of these fatal crashes occurred at nighttime, when the rate of alcohol-involved crashes was 4.5 times higher than during the day, and on the weekend, then the number of alcohol-involved crashes was nearly two times greater than during weekdays. These levels of fatalities persist in spite of a decades-long downward trend in fatalities involving alcohol-impaired drivers in the US (National Highway Traffic Safety Administration, 2012).

The age groups accounting for the largest proportion of alcohol-involved motor vehicle fatalities are 21-24, 25-34, and 35-44 years, who accounted for 33, 29, and 26 percent of all drivers involved in fatal crashes, respectively in 2011. Rates of alcohol-impaired driving increase sharply at age 21, when it becomes legal to purchase alcoholic beverages in the US

(Beck et al., 2010). Male alcohol-impaired drivers are more common than female, with the large majority of impaired drivers involved in crashes being male (National Highway Traffic Safety Administration, 2012). Although these are statistics from one year, they demonstrate a pattern that has remained consistent for some time. Several studies have also reported race/ethnicity differences in alcohol-involved crashes (Braver, 2003; Caetano & McGrath, 2005; Caetano, Ramisetty-Mikler, & Rodriguez, 2008; Delcher, Johnson, & Maldonado-Molina, 2013). For example, Roudsari and associates (Roudsari, Ramisetty-Mikler, & Rodriguez, 2009) found that among males and females of Asian descent both had lower percentages of fatalities with BACs of .08 or greater compared to other race/ethnic groups.

Social norms are hypothesized to play an important role in at-risk drinking generally, and in drink/driving (i.e., driving after consuming alcohol), specifically. Injunctive norms are a specific form of social norms based on individual perceptions of what important others expect them to do and not do, and a concept in the Theory of Normative Social Behavior (TNSB) (Rimal, 2005; Rimal & Real, 2003). According to TNSB, three normative mechanisms moderate the association between descriptive norms and behavior: Injunctive norms; outcome expectations; and group identity. Descriptive norms refer to individuals' perceptions of the prevalence of a behavior, and have been shown to generally be exaggerated (Perkins & Berkowitz, 1986). The greater the perceived prevalence of a behavior, the more likely an individual is to construe their own excessive behavior as being normative (Perkins, Meilman, Leichliter, Cashin, & Presley, 1999). Injunctive norms are an individual's perception that influential others expect them to behave in a specific manner, and that negative social consequences will ensue if they do not (Rimal, 2005; Rimal & Real, 2003). Outcome expectations include anticipated benefits to self and others, and anticipatory socialization (i.e., being welcomed into a peer group). Group identity is the individual's perceived self-similarity to a specific group, and their aspiration to belong to that group. According to TNSB, injunctive norms modify the association between descriptive norms and behavior, and can be so strong that a person's behavior is opposite what would be expected based on their descriptive norms (Rimal, 2005).

The role of injunctive norms on drink/driving behavior of college students was examined in a paper by LaBrie and associates (LaBrie, Napper, & Ghaidarov, 2012). Students were found to consistently overestimate their peers' approval of drink/driving, and this overestimation was predictive of drink/driving behavior. The operationalization of injunctive norms as consisting entirely of peer approval is somewhat limited, and while this research is suggestive of the role of injunctive norms in drink/driving behavior, it fails to test the broader concepts of TNSB.

Aims

The purpose of this paper was to examine the role of the Theory of Normative Social Behavior in predicting drink/driving behavior of young adult males and females using both parental and peer indicators of injunctive norms.

Methods

Participants / Data Collection

Young adults who previously participated in a longitudinal study evaluating a school-based alcohol misuse prevention program (Shope, Copeland, Maharg, & Dielman, 1996; Shope, Dielman, Butchart, Campanelli, & Kloska, 1992), and who had a Michigan driver license (N=10,627) were invited to complete a telephone interview during 1997-1998, approximately six years following their high school graduation. The participants averaged 23.5 years of age, and were 49% male, 26% married, 88% white, 22% had at least one child, and a median household income of US $25,000-$34,999. All the respondents (n=5,464) had previously completed at least one of six school-administered questionnaires from grade 5/6 through 12. The University of Michigan Medical School's Institutional Review Board approved the study for Human Subject Research.

Measures

Demographics

Demographics included sex, marital status (1=ever married, 0=never married), race (1=white, 0=other), income (≤$5,000, $5,000-14,999, $15,000-24,999, $25,000-34,999, $35,000-44,999, $45,000-54,999, ≥$55,000), parent status (1=yes, 0=no), and church attendance (1=annually, 2=monthly, 3=weekly, 4=daily).

Descriptive Norms

Two single items measured the perceived number of friends who drank alcohol or smoked marijuana regularly. Perception of friends' alcohol use was measured as the mean of three items assessing how many close friends drink alcohol weekly or more often, have five or more drinks when drinking and, drove at least once in the past year after drinking three or more drinks (1=none, 2=some, 3=about half, 4=most, or 5=all).

Injunctive Norms

Two single items measured the likelihood that friends or parents would ride with the participant after s/he had been drinking (1=very unlikely, 2=somewhat unlikely, 3=somewhat likely, or 4=or very likely). The comparative influence of parents versus friends on participants was measured as the mean of three items asking who the respondent would ask for advice regarding an important decision (1=parents more, 2=parents and friends equally, or 3=friends more). Friends' and parents' approval of alcohol misuse by the respondent was measured as the means of two pairs of items regarding binge drinking and drink/driving (1=disapprove strongly, 2=disapprove, 3=neither approve nor disapprove, 4=approve, or 5=approve strongly).

Outcome Expectations

Six items measured the likelihood of negative outcomes of drink/driving (1= very likely, 2=somewhat likely, 3=somewhat unlikely, or 4=very unlikely). Drink/driving risk was measured by a single item asking how dangerous it would be for a man/woman to drive within an hour of having three/two alcoholic drinks (1=very dangerous, 2=somewhat dangerous, 3=a little dangerous, or 4=not at all dangerous). Risk-taking propensity was measured as the mean of four items (1=not at all like me, 2=a little like me, or 3=a lot like me).

Alcohol Misuse and Drink/Driving: Outcome Measures

Alcohol misuse was measured using the AUDIT (Babor, la Fuente, Saunders, & Grant, 1992), a 10-item clinical diagnostic tool for measuring at-risk drinking. A total score was calculated as the sum across item responses. Drink/driving was measured as the mean of five items asking how many times in the past year participants had driven after drinking or while feeling impaired by alcohol (1=1; 2=2; 3=3; 4=4; 5=5; 6-9=6; 10-14=7; 15-19=8; 20-24=9; 25-29=10; 30-49=11; 50-99=12; 100 or more=13) (Donovan, 1993).

Statistical Analysis

Descriptive statistics and hierarchical multiple regression models were estimated using SAS Release 9.2. Two hierarchical multiple regression models were estimated separately by sex. The first pair of models predicted alcohol misuse, and the second pair predicted drink/driving. Hierarchical blocks of variables were entered in the following order: Model 1 (M1), descriptive norms; Model 2 (M2), injunctive norms; Model 3 (M3), outcome expectations; and in the model predicting drink/driving, Model 4 (M4), alcohol misuse. All models were adjusted for demographic characteristics.

Results

Alcohol Misuse

Descriptive norms accounted for 37% of the variance in alcohol misuse for men and 32% for women (Table 1). When injunctive norms were added the model the estimates for descriptive statistics were reduced in size but there was no change in significance, and the model accounted for 41% and 35% of the variance in alcohol misuse for men and women, respectively. Adding outcome expectations caused a further reduction in estimate size for descriptive norms, and resulted in a change in significance for women. The model accounted for 42% and 38% of the variance in alcohol misuse for men and women, respectively.

Table 1. Predictors of alcohol misuse (estimates in bold significant at $p<0.05$)

Theoretical Construct	Predictor Variables	Men			Women		
		M1	M2	M3	M1	M2	M3
Descriptive Norms	Friends' Marijuana Use	0.12	0.11	0.08	0.08	0.07	0.09
	Friends' Alcohol Use	**0.51**	**0.39**	**0.31**	**0.21**	**0.17**	0.12
	Friends' Risky Drinking	**2.47**	**2.07**	**1.99**	**1.65**	**1.39**	**1.28**
Injunctive Norms	Friend Drink Ride		0.19	0.11		**0.47**	**0.36**
	Parent Drink Ride		0.06	0.15		**0.33**	**0.31**
	Parent/Friend Influence		**0.59**	**0.52**		**0.40**	**0.25**
	Friends Approve Binging		**0.85**	**0.75**		0.09	0.02
	Parents Approve Binging		0.10	0.03		**0.38**	**0.36**
Outcome Expectations	Drink/driving Outcomes			0.03			**0.16**
	Drink/driving Risk			**0.55**			**0.30**
	Risk Taking Propensity			**0.67**			**1.20**
	R^2	**0.37**	**0.41**	**0.42**	**0.32**	**0.35**	**0.38**

Drink/Driving

Descriptive norms accounted for 34% of the variance in drink/driving for men and 26% for women (Table 2). Adding injunctive norms to the model increased the predicted variance to 40% and 33% for men and women, respectively, and reduced the effect of descriptive norms on drink/driving, but there was no change in significance. With outcome expectations included the model accounted for 42% of the variance in drink/driving by men and 37% by women. The addition of outcome expectations further reduced the effect of descriptive norms, but did not change significance. Finally, the addition of alcohol misuse to the model accounted for a total of 47% of the variance in drink/driving for both men and women, reduced the effect of descriptive norms, but did not change significance for that construct.

Discussion and conclusions

This research used the Theory of Normative Social Behavior (TNSB) (Rimal, 2005) to examine the moderating effect of normative mechanisms, including injunctive norms and outcome expectations on the association between descriptive norms and alcohol misuse and drink/driving. The results support the role of injunctive norms and outcome expectations on alcohol misuse and drink/driving behavior, and have implications for future research and efforts to reduce drink/driving among young adults.

Table 2. Predictors of drink/driving (estimates in bold significant at $p<0.05$)

Theoretical Construct	Predictor Variables	Men				Women			
		M1	M2	M3	M4	M1	M2	M3	M4
Descriptive Norms	Friends' Marijuana Use	-0.09	-0.09	-0.08	-0.08	-0.02	-0.02	-0.02	-0.04
	Friends' Alcohol Use	**0.38**	**0.28**	**0.22**	**0.18**	**0.33**	**0.30**	**0.26**	**0.26**
	Friends' Risky Drinking	**1.27**	**0.91**	**0.84**	**0.59**	**0.79**	**0.57**	**0.49**	**0.22**
Injunctive Norms	Friend Drink Ride		**0.37**	**0.29**	**0.29**		**0.46**	**0.38**	**0.33**
	Parent Drink Ride		**0.16**	0.10	0.09		0.07	0.07	0.02
	Parent/Friend Influence		0.10	0.04	-0.06		**0.15**	0.04	-0.01
	Friends Approve Binging		**0.31**	**0.25**	**0.15**		0.00	-0.06	-0.02
	Parents Approve Binging		0.07	0.00	-0.02		0.11	0.08	0.01
Outcome Expectations	Drink/driving Outcomes			0.12	0.12			**0.12**	0.08
	Drink/driving Risk			**0.37**	**0.30**			**0.35**	**0.29**
	Risk Taking Propensity			**0.38**	**0.29**			**0.60**	**0.33**
Alcohol Misuse	AUDIT				**0.18**				**0.24**
	R^2	**0.34**	**0.40**	**0.42**	**0.47**	**0.26**	**0.33**	**0.37**	**0.47**

Social norms provide an indicator of the acceptability of behavior, and gauge the degree to which different behaviors are proscribed or desired among close friends, family members, acquaintances, and society. This research confirms past research, demonstrating the influence of social norms, both descriptive and injunctive, on alcohol misuse and drink/driving (Brooks-Russell, Simons-Morton, Haynie, Farhat, & Wang, 2013; Cleveland et al., 2013; Wardell & Read, 2013).

As posited based on TNSB, descriptive norms in the form of perceptions of friends' use of alcohol was directly associated with participants' levels of alcohol misuse and drink/driving. The strength of this association was reduced when the models were adjusted for injunctive norms and outcome expectations, but the effect of descriptive norms remained significant. This result indicates that injunctive norms and descriptive norms independently contribute to alcohol misuse and drink/driving. The relatively small change in the estimates of descriptive norms when injunctive norms were added to the model indicates that the contributions of these two are largely independent parallel processes. Similar patterns are observed with outcome expectations when predicting alcohol misuse and drink/driving.

Past research examining the role of injunctive norms in drinking behavior has found evidence that past behavior is predictive of subsequent norms, which in turn predict behavior longitudinally (Carcioppolo & Jensen, 2012). Alcohol misuse was added last to the model predicting drink/driving in order to adjust the effects of descriptive and injunctive norms and outcome expectations for level of alcohol misuse. Rather than reducing the effects of these previously entered constructs in the model, the addition of alcohol misuse provided additional prediction to the model. This is somewhat counter to research suggesting a reciprocal interaction between norms and behavior, in which case it would be expected that including alcohol misuse would yield a more dramatic reduction in the predictions by descriptive and injunctive norms, and outcome expectations.

The results of this research have implications for interventions to reduce drink/driving, suggesting that enhancing an individual's perceptions of important others' expectations that they not drink drive, and reducing the expectation that drink/driving will lead to personally beneficial outcomes is one approach to prevent or reduce drink/driving behavior. This approach might be enhanced if descriptive norms were altered in the direction of less drink/driving and alcohol misuse. Programs, both marketing and broad media campaigns that continue to shift social and cultural norms away from acceptance of drink/driving are important; however, these broader norms must also be reinforced through the examples of others. This approach is much in line with Social Cognitive Theory (Bandura, 1986), which suggests that individual behavior change occurs in a reciprocal interaction between the individual, social and cultural norms evident in the individual's context, and injunctive norms arising from individual values, ideas and perceptions, leading ultimately to behavior (Wardell & Read, 2013).

Strengths and Limitations

This research has significant strengths, including a large sample, and constructs assessed by multiple measures. In addition, though the sample is not representative in the strict sense, participants were originally recruited from a sample of public schools, and are therefore very characteristic of the population, and provide results that are broadly indicative of associations that would be expected in the population. Limitations also include attrition, cross-sectional measurement, and an assessment design relying on telephone surveys, which may have systematically included participants who were easier to reach by phone due either to accessibility to a personal phone, or the means to employ call-screening privacy services. Also, a standardized measure of descriptive and injunctive norms was not used, and instead the constructs of TNSB were measured using available survey items. Finally, the manner in which the models were constructed was not perfectly in line with TNSB, which posits that injunctive norms and other normative mechanisms interact with and modify the association of descriptive norms with subsequent behavior. Instead, these models test the degree to which the two processes operate in parallel. Future research should test this theory using structural equation modeling techniques and testing for moderation effects.

Future research should continue to examine the roles of descriptive and injunctive norms in alcohol misuse and drink/driving. This would be aided by the development of standardized approaches to the measurement of descriptive and injunctive norms.

Conclusions

Both descriptive and injunctive norms and outcome expectations play a role in the prediction of drink/driving behavior that is not accounted for by the level of alcohol misuse. These findings suggest that interventions to reduce drink/driving may be effective without requiring that drinking behavior be changed. It may be sufficient for interventions to focus more exclusively on shaping norms and expectations at both the social/cultural and individual level to have the desired effect of reducing or preventing drink/driving and the fatalities and injuries that result from it.

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Drug Use Among Drivers in Canada

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Abstract

Roadside surveys have been conducted periodically in British Columbia, Canada since 1995 as a surveillance tool to gather reliable and valid estimates of the prevalence of alcohol use by nighttime drivers. With concerns about the consequences of driving while under the influence of drugs coming to the forefront of public attention, the roadside survey conducted in 2008 was the first to introduce drugs into the testing protocol. Two subsequent surveys have also included drug testing. Using the combined data from three roadside surveys (conducted in 2008, 2010 and 2012), we examined the characteristics of drivers who tested positive for drugs and the circumstances under which the behaviour occurred. The method for all three roadside surveys followed a standard protocol. There were a total of 4711 drivers that voluntarily participated and provided both an oral fluid sample and a breath sample. It was found that 3928 (83.4%) were negative for both drugs and alcohol, 382 (8.1%) were positive for drugs only, 320 (6.8%) were positive for alcohol only and 81 (1.7%) were positive for both drugs and alcohol. Results indicate that the characteristics of drug-drivers and the patterns of drug use by drivers differed from the well-known patterns of drinking and driving. The most common drug detected was cannabis followed by cocaine. This information makes a vital contribution to the development of effective enforcement, public education and awareness programs.

Background

Following two decade of progress on the alcohol-crash problem, safety advocates, policy makers, legislators and enforcement agencies have begun to express greater concern about the use of drugs by drivers. Epidemiologic studies of drug use among fatally injured drivers in Canada indicate that drugs, often in combination with alcohol, are detected in up to 30% of such cases (e.g., Beirness and Beasley 2013). The Canadian Addiction Survey found that 4.8% of drivers in Canada admit to having driven within two hours of using cannabis at least once in the past year. Among those aged 16 to 18, 20.6% reported having driven after using cannabis, slightly higher than the 19.6% who reported driving after drinking (Beirness and Davis 2007).

Over the past 30 years, roadside surveys of drivers in Canada have contributed a great deal to our understanding of drinking-driving behaviour. In recent years, oral fluid has emerged as a convenient and unobtrusive means to assess drug use. More importantly, drugs detected in oral fluid are more likely the result of recent drug use and active drug effects – including the impairment of driving performance. In 2008, the roadside survey conducted in British Columbia was the first to introduce drugs into the testing protocol. Two subsequent surveys (2010 and 2012) also included drug testing.

Aims

Using the combined data from three roadside surveys (conducted in 2008, 2010, 2012), we examined the characteristics of drivers who tested positive for drugs and the circumstances under which the behaviour occurred.

Methods

The roadside surveys were all conducted using the same data collection procedures. Drivers were randomly selected from the traffic flow at pre-selected locations in four time periods (21:00-22:30; 22:30-00:00; 00:00-01:30; and 01:30-03:00) on Wednesday, Thursday, Friday, and Saturday nights in June 2008, 2010, and 2012 and asked to voluntarily provide a sample of breath and oral fluid for analysis of alcohol and drug content. Further details of the procedure can be found elsewhere (Beirness and Beasley 2010).

Results

A total of 6,884 vehicles were randomly selected from the traffic flow for participation in the three surveys. Among the vehicles selected, 88.2% of drivers provided a breath sample and 72.1% provided an oral fluid sample.

There were 4,711 drivers that provided both an oral fluid sample and a breath sample. These drivers were divided into four groups as according to drug and alcohol use: Alcohol and Drug Negative (n=3928, 83.4%), Drugs Only (n=382, 8.1%,), Alcohol Only (n=320, 6.8%), and Alcohol and Drugs (n=81, 1.7%) Overall, 16.6% of drivers tested positive for either alcohol, drugs or both.

Survey Night

Figure 1 presents the percentage of drivers in the Drug and Alcohol groups according to survey night. (The Alcohol and Drug Negative group is not shown.) Overall, the groups were independent of survey night ($\chi^2 = 12.0$, df = 9 p>.20). Further analysis revealed that the Alcohol and Drug groups show different patterns across survey nights (χ=10.3 df=3 p<.02). Whereas the Alcohol group was more prevalent on weekend nights, the percentage of drivers in the Drug group was higher on weekdays.

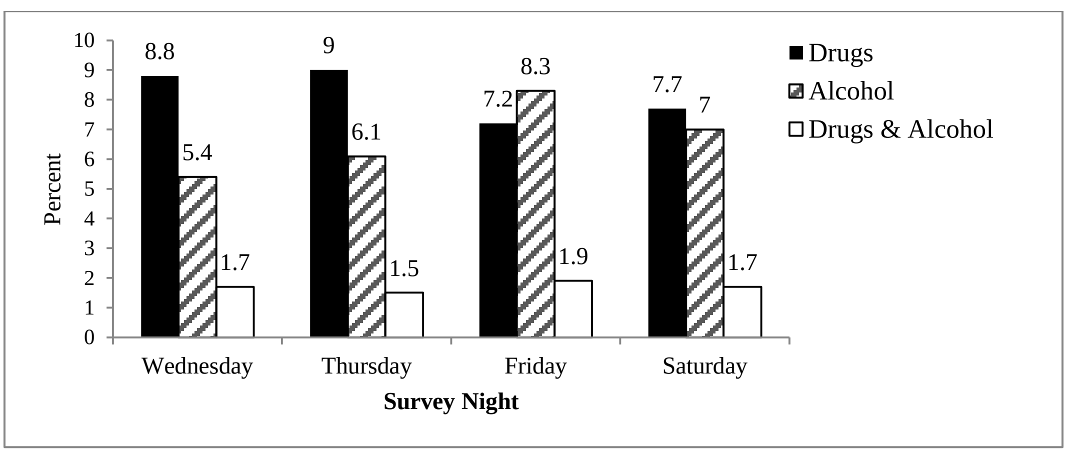

Figure 1: Drug and Alcohol Groups According to Survey Night

Survey Time

Figure 2 shows in the percentage of drivers in the Drug and Alcohol groups according to survey time (χ^2 = 51.3, df = 9 p<.001). While the percentage of drug positive drivers was more consistent across survey time, alcohol positive drivers and drivers that were positive for both drugs and alcohol were most common in the late night site (01:30 - 03:00).

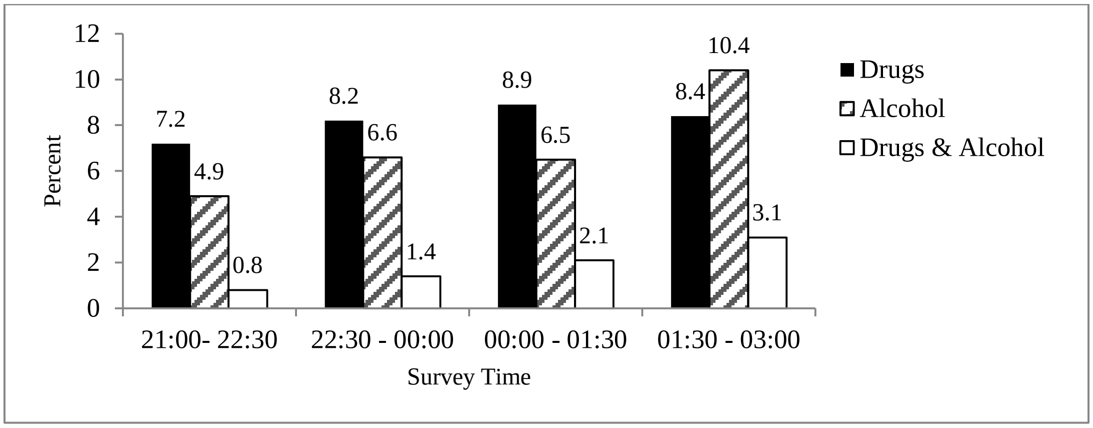

Figure 2: Drug and Alcohol Groups According to Survey Time

Driver Sex

Table 1 presents the Drug and Alcohol Groups according to sex. Overall, male drivers comprised 64.5% of all drivers. Males had higher rates of substance use than females (χ^2=51, df=3 p<.001). Whereas males were more likely to test positive for drugs (9.6%) than alcohol (7.4%), females were almost equally likely to test positive for drugs (5.4%) and alcohol (5.6%).

Group	Male (n=3017)	Female (n=1650)	Total Drivers (% Male)
Negative (%)	80.6	88.2	3889 (62.6)
Drugs Only (%)	9.6	5.4	380 (76.6)
Alcohol Only (%)	7.4	5.6	317 (70.6)
Drugs and Alcohol (%)	2.3	0.7	81 (85.2)
Total (%)	64.6	35.4	4667

Table 1: Drug and Alcohol Groups According to Sex

Age

Figure 3 presents the Drug and Alcohol groups according to age group. Drug and alcohol use among drivers differed significantly across age groups (χ^2 = 47.7, df = 15 p<.001). In particular, whereas drug use was more consistent across all age group, alcohol use was most prevalent among drivers 19 to 44 years old. Among those 16 to 18 years of age, drug use was four times more common than alcohol use.

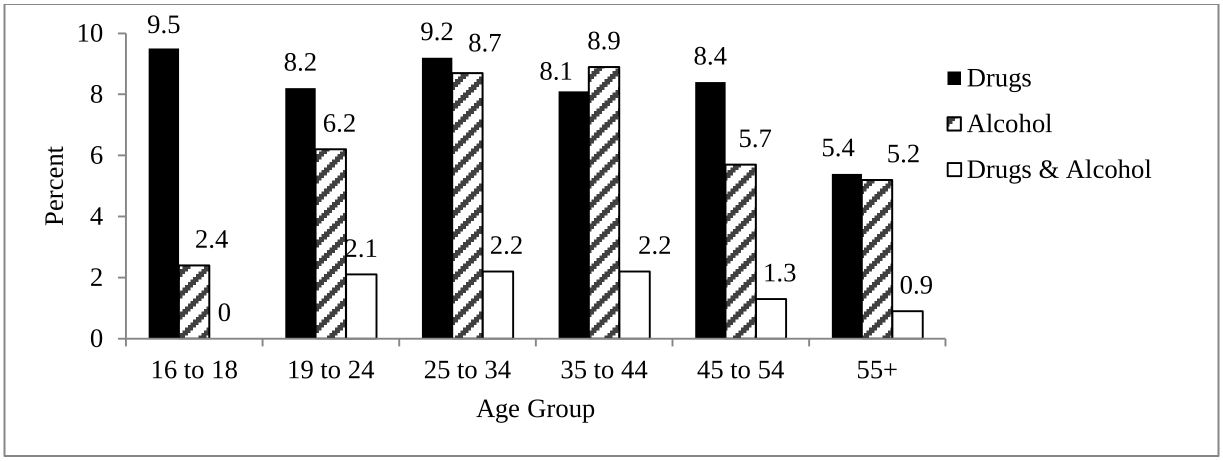

Figure 3: Drug and Alcohol Groups According to Age

Trip Origin

Drivers were asked where they were coming from prior to participating in the survey. The home of a friend or a relative was the most common location for all three groups of drivers (ranging from 31.3% to 39.5%). Only 9.7% of alcohol-positive drivers came from bar/pub/nightclubs. Of note, 15.6% of drug-positive drivers, 15% of alcohol-positive drivers and 7.4% of alcohol and drug positive drivers indicated they were coming from work.

Drug Type

Table 2 presents the number and percentage of drivers that tested positive by drug type. This includes the drivers that tested positive for drugs only as well as those who also tested positive for drugs and alcohol. Cannabis was the most common drug detected. There were 66 drivers (14.2% of all drug-positive drivers) that tested positive for more than one drug. Cocaine and cannabis was the most common drug combination.

Drug Type	Number of Drivers Tested Positive	Percentage of All Drug Positive Drivers	Percentage of All Tested Drivers
Cannabis	261	56.1	5.5
Cocaine	174	37.4	3.6
Opiates	66	14.2	1.4
Amphetamine/Methamphetamine	27	5.8	0.6
Benzodiazepines	6	1.3	0.1

Table 2: Drug Types Detected among Drug-Positive Drivers

Table 3 presents drug type by driver sex. Cannabis was the most common drug detected among both sexes. Cocaine was more frequently detected among males. Females had higher rates of opiates, amphetamines/methamphetamines and benzodiazepines.

Drug Type	% of Male Drug Positive	% Females Drug Positive	% of drug Type Male
Cannabis	58.8	46.5	81.9
Cocaine	38.7	32.7	80.9
Opiates	13	18.8	71.2
Amphetamine/Methamphetamine	5.0	8.9	66.7
Benzodiazepines	1.1	2	66.7

Table 3: Drug Type According to Sex

Table 4 presents the percentage of each drug type detected in drug positive drivers according to age. Recall that poly-drug use was common. Cannabis is the most common drug across all age groups. Among those 16 to 18 years of age, 76% of drug-positive drivers were positive for cannabis. The prevalence of cannabis use decreased with age. Among those 55 and older, drivers were almost equally likely to test positive for cannabis and opiates.

Age Group	**Cannabis (%)**	**Cocaine (%)**	**Opiates (%)**	**Benzodiazepines (%)**	**Amphetamine/ Methamphetamine (%)**
16 to 18	76	28	12	0	4
19 to 24	66.4	24.9	10.3	0	4.3
35 to 34	58.9	30.6	8.9	1.6	7.3
35 to 44	51.3	20.2	12.5	0	3.8
45 to 55	48.6	14.5	21.6	0	6.8
55+	32.6	5.8	30.2	9.3	9.3

Table 4: Drug Types Detected According by Age

Discussion and Conclusions

These roadside surveys highlight the fact that drug and alcohol use by drivers is common. The frequency of drug use by drivers rivals that of alcohol use. In this context, however, it should be noted that the analytic procedure tested for a limited set of substances most likely to be used by drivers (i.e., cannabis, cocaine, opiates, amphetamines, methamphetamine and benzodiazepines). To the extent that other substances may have been used by drivers, the present findings should be viewed as a conservative estimate of the prevalence of drug use.

The pattern and characteristics of drug-positive drivers differed from those of alcohol-positive drivers. Drug use was found across all survey nights and across all survey times whereas alcohol use was more prevalent during late night weekend hours. Law enforcement needs to recognize that impaired drivers are on the road at all times of day and are not restricted to traditional weekend late night hours associated with drinking. Expanding enforcement activities could have direct road safety benefits.

Drivers 16 to 18 were most likely to test positive for drugs yet drug use was seen across all age groups including drivers over 55. Those 16 to 18 were more likely to test positive for drugs than alcohol. Males were more likely to be positive for drugs than females and were more likely to test positive for more than one drug. The pattern of drugs they tested positive for was different. Although cannabis is the most commonly found drug among females, they were more likely to test positive for opiates, benzodizepines, amphetamines, methamphetamine than males. There was also a different pattern of drug types seen according to age group.

Although many of the alcohol-impaired driving prevention campaigns and policies in the past three decades have targeted bars, pubs and nightclubs, the present research indicated that the majority of alcohol-positive drivers were coming from private homes, either theirs or the home of a friend of relative. The majority of drug-positive drivers were also coming from a private residence. This presents a direction for prevention campaign as they could inform people about the harms of letting friends or family drive while under the influence of drugs. Also a concern is the number of drug or alcohol positive drivers that indicated they were coming from work. It is not clear if consumption of alcohol or drugs took place at work or in their vehicle after leaving work. Further investigation of the nature and extent of this behaviour is warranted so that appropriate measures can be taken. Understanding which drivers are most likely to test positive for drugs can lead to more effective prevention campaigns.

The roadside surveys provide valuable insights into the patterns and characteristics of those who drive after using drugs. Driving after drug use differs from driving after alcohol use and required a different approach to prevention and enforcement.

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Survey Guidelines to Assess Driver Alcohol & Drug Use

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ABSTRACT

Context: Roadside surveys of alcohol use among drivers have been used for many years to measure the prevalence of alcohol use among drivers. The technique involves randomly selecting drivers from the traffic flow and asking them to provide a sample of breath. Whereas other measures of the drinking-driving problem rely on official reports of events that have come to attention of police (i.e., crashes and arrests), roadside surveys provide an estimate of the extent to which drivers in the general population have been drinking. Over time this method has been modified to include the collection of drug use from drivers as well as examining the collection of data during daytime hours.

Objectives: A standard protocol for these surveys is required to compare results across jurisdictions and/or over time. The objective of this project was to describe a standard protocol for conducting a roadside survey to determine the prevalence of alcohol and drug use among nighttime drivers. In addition, the document addresses many of the issues and questions that arise when a roadside survey is being considered and provides an overview of many of the steps required to help ensure a successful project

Key Outcomes: A roadside survey is a major effort that requires considerable forethought, planning, negotiations with key stakeholders and partners, and the development of a detailed protocol for the survey. It is an intensive effort that requires a tremendous amount of preparation. The key to a successful project is careful planning and a standard protocol will provide guidance in this process.

Discussion and conclusions: This protocol has been developed over time and modified to add drug collection and examine the use of daytime sites. These procedures have been tested and improved in multiple surveys conducted in Canada over past decades. The result is a protocol that addresses key issues and concerns and provides valid measurements of general alcohol and drug use on a jurisdiction's roads which can be monitored overtime or used as a before and after measurement system.

BACKGROUND

One of the first reported roadside breath testing surveys was conducted in Evanston Illinois over 70 years ago (Holcomb, 1938). The first roadside breath testing survey in Canada was conducted in Toronto in 1951-52 (Lucas et al, 1955). Perhaps the most often cited survey of this type was conducted in Grand Rapids, Michigan as part of a case-control study during the early 1960s by Dr. Robert Borkenstein and colleagues (Borkenstein et al, 1964). This study was instrumental in establishing the increased risks associated with driving with elevated blood alcohol concentrations (BACs) and in setting per se limits for the legal BAC threshold.

By 1971, a total of 19 roadside surveys had been conducted in eight countries. The results of this research served to underscore the importance of this type of survey for determining the magnitude of the drinking-driving problem and for the evaluation of countermeasure strategies and programs. However, the use of different methodologies and analytic techniques rendered it difficult to compare the results among countries.

In 1972, under the auspices of the Organization for Economic Cooperation and Development (OECD), an international group of scientists chaired by Dr. Carl Stroh of Canada was charged with the responsibility of developing a research protocol for the conduct of roadside breath testing surveys (Stroh, 1974). The standard methodology was first used in a pilot roadside survey project conducted by Transport Canada in Alberta and New Brunswick. The success of the pilot project led to the 1974 National Roadside Survey of the BACs of the driving population (Smith et al, 1976). Since that time a number of surveys have been conducted in a few Canadian jurisdictions.

In the United States, roadside surveys have been conducted periodically to monitor the prevalence and extent of alcohol use by drivers. The first national roadside survey in the United States was conducted in 1973 (Wolfe, 1974). National surveys in the United Sates were also completed in 1986 (Lund & Wolfe, 1991) and 1996.(Voas et al, 1998) Most recently, a national alcohol and drug roadside survey was conducted in 2007 (Lacy et al, 2009) . At least two states (Minnesota, North Carolina) have undertaken independent state-wide roadside surveys (Foss et al, 1997).

Roadside surveys have also been conducted for many years in several parts of Europe (Germany, Sweden, Belgium, Netherlands, Finland, and the United Kingdom). Australia (Perth, New South Wales), and Africa (Kenya, South Africa) (Jackson, 2008). Although the general approach is similar to surveys conducted in North America, variations in procedures are common – e.g., days of the week, time of day, site selection, conducted at night. In countries where random breath test laws (e.g., Australia) require drivers to provide a breath test when requested by a police officer, it is common for the survey to be conducted by enforcement personnel. As might be expected in this situation where refusal to provide a sample can have legal ramifications, response rates are very high.

SURVEY METHOD

The purpose of a roadside survey is to obtain an estimate of the prevalence of alcohol and drug use among a random sample of drivers on the road. Collecting these data from drivers at randomly selected locations throughout the targeted communities ensures a valid and reliable estimate of the overall prevalence of alcohol and drug use. This goal can often be different than impaired driving enforcement activities such as police impaired driving check stops. Quite often the enforcement activity is not done at a random location, for a specified period of time and is more selective in which vehicles/drivers are selected for assessment. The situation is different in jurisdictions with random breath test legislation, as drivers can be compelled to provide a breath sample.

The roadside survey method used throughout North America has evolved from the original research protocol developed and approved by the OECD in 1972. The sampling procedures remain the same but the survey methods have been streamlined and updated to take advantage of advancements in breath test technology.

There are a number of significant partners to be considered when developing a roadside survey. Police services in the regions where the survey will take place are key partners to manage traffic on the road and redirect vehicles into the study area. The use of off duty officers can provide more control over their involvement in the study and it is important that officers understand their contribution is to direct traffic into the site safely and count the passing vehicles for weighting purposes.

Other sponsors of the survey can be useful to provide a small incentive for drivers to participate. Such an incentive tends to increase the response rates in these surveys and can offer some profile for the sponsoring organization.

The selection of the sites is key to the validity of conclusions drawn from the results and should be done through random assignment. Site selection requires the survey region to be specified in advance, (i.e. the boundary of a city). A numbered grid is then applied to a map of the region. The grids to be surveyed are randomly selected and all possible survey sites within the grid form the population and the survey sites are selected, without replacement. All selected sites should be visited to ensure they comply with the site operational and safety requirements.

The survey is conducted by a team of interviewers who have been specially trained in survey operations, interview techniques, and the use of the breath alcohol test and oral fluid collection equipment. In addition to four to five interviewers, a survey team should include a crew chief to supervise the site and address challenges, a police officer to stop and direct traffic into the site and count passing vehicles, and a traffic coordinator to direct traffic into the survey bays.

Often these types of surveys take place during the evening and early morning periods of selected days. Multiple teams can be utilized in a specific geographic location in one evening. Restricting the time at each site allows for greater geographic representation and prevents drivers from either avoiding the site or repeatedly driving past the site in an attempt to be selected to obtain incentives.

Survey sites are usually set up in an area off the travelled roadway such as in a parking lot. The sites must be selected in advance to ensure sufficient travel flow past the site during the survey times, the appropriateness of the site in terms of lighting and ingress and egress for vehicles and to seek advance approval and permission from the property owner to use the site and potentially leave a few vehicles on the site until the next day. This affords a greater degree of safety for the survey team and drivers than would be the case if interviews were conducted on the side of the road. This approach also permits several interviews to be conducted simultaneously.

When an interviewer is ready to begin an interview, the traffic coordinator signals the police officer to select the very next eligible vehicle (i.e., non-commercial light duty vehicle) from the traffic flow and direct it into the survey site. It is essential that the police officer select the next vehicle that can be stopped safely to ensure a pseudo-random selection of vehicles from the traffic stream.

The traffic coordinator then directs the driver to an empty bay and the interviewer first greets the driver, outlines the general nature of the survey and hands the driver a card that explains the details of the survey. After the driver has agreed to participate, the interviewer ensures that the driver understands that the interview is voluntary and confidential. The interview typically includes a short series of questions concerning attitudes, opinions, and knowledge about drinking and driving. The purpose of the questions is not only to gather pertinent information about drivers and their opinions about impaired driving issues but also to provide a brief opportunity for the driver to become comfortable with the interviewer, to allow the driver to feel that they are contributing, and to facilitate the transition to providing a breath sample.

The interview concludes with the driver voluntarily providing a breath sample into a small, hand-held breath testing device approved for use. Some drivers may attempt to provide an incomplete sample and interviewers must be taught how to recognize and address this issue.

Drivers who are below the jurisdictional administrative or legal limit are thanked and directed off the site. Drivers with a BAC in excess of the administrative or legal limit for the jurisdiction are asked to speak with the Crew Chief who engages the driver in a conversation for a few minutes prior to administering a second breath test with a different device. This interval helps to ensure that any mouth alcohol that might possibly have contaminated the first reading will have dissipated. The purpose of the second breath test is to confirm the result of the first test and to demonstrate to the individual that they should not be driving. Alternative transportation home should be provided possibly by taxi or volunteers. The vehicle can be left at the site if no non-impaired passenger is able to take over behind the wheel. No person with a BAC over the limit for that driver's status is allowed to drive away from the survey site.

A PROTOCOL FOR DRUG TESTING

At one level, expanding a roadside alcohol survey to include drugs merely involves the addition of a drug test into the protocol. However, in reality it is not quite so simple. There are numerous issues to be considered. Firstly, the issue of sample medium must be decided. Whereas breath has been the sample medium of choice for alcohol testing in surveys and enforcement, breath cannot be used to assess drug use among drivers. The choices are urine, blood, and oral fluid. Each has its strengths and limitations.

Urine has long been used as a medium for drug testing. Although not generally considered to be as intrusive as blood sampling, participants require a private and sanitary place to provide the sample and many people are reluctant to volunteer. The major drawback of urine as a sample medium, however, is that levels of substances detected in urine do not necessarily represent levels of active drugs and, in some cases, may reflect inactive drug metabolites that have no effect on driver behaviour. Of particular interest in this context are cannabis metabolites, which can be detected in urine up to several weeks after use.

Blood is the medium of choice for detecting and measuring drug levels. Drug levels in blood reflect pharmacologically active substances most likely associated with observed levels of behavioural and cognitive impairment. The major limitation is the intrusiveness involved in obtaining a blood sample. A qualified phlebotomist must be employed to collect samples in a safe and healthy manner. Besides issues of liability surrounding the drawing of the blood sample, drivers are often reluctant to provide a sample of blood, especially at the side of the road.

Laboratory testing of blood samples is expensive but generally provides the most valid evidence of drug use.

Oral fluid is becoming the medium of choice for quick, unobtrusive, and accurate screening and testing of psychoactive substances. Oral fluid can be collected while the driver remains in the vehicle by means of an absorbent pad attached to a plastic stick placed under the tongue or between the teeth and cheek for a few minutes. Drugs detected in oral fluid are better correlated with active drug levels in the blood than is the case with urine. The major limitation of oral fluid is limited transfer of some drugs to oral fluid – e.g., benzodiazepines do not transfer well. The amount of fluid collected can also be a limiting factor. Some people have difficulty producing a sufficient volume of oral fluid in a brief period of time. A minimum of 1ml of fluid is required for testing. Rather than relying on the passage of a set period of time to gather an oral fluid sample, some collection devices provide a visual display that indicates when sufficient fluid has been collected.

Adding the collection of oral fluid samples to the procedure increases the amount of time required to complete each interview. Hence, rather than the three to four minutes required for alcohol surveys, interviews that seek to obtain samples to test for both alcohol and drugs will require an average of seven to eight minutes. This will reduce the number of interviews that can be collected in the allotted time at each site and reduce the overall sample size.

Typically the oral fluid samples will have to be sent by courier to a certified lab for analysis for commonly found drugs of interest. Samples are initially screened in the lab for cannabis, cocaine, opiates, amphetamines, methamphetamine, and benzodiazepines using enzyme immunoassay technology. Samples with a positive screen are confirmed by gas chromatography/mass spectrometry (GC/MS) at an pre-approved detection level.

The analysis of these types of data are somewhat complex. The data need to weighted by the total number of passing vehicles to reflect the relative contributions of each site. This is the data element the police officer collects at the time of the survey. All regions being surveyed are not the same in terms of driver and population density, gender breakdowns and perhaps other important factors. In order to make the data the most representative for the entire jurisdiction it is important the sites and vehicles be randomly selected and the data be weighted appropriately. The selection of the weighing methodology is very important in terms of the validity of the results. Monitoring the refusal rates for both drug and alcohol measurement is very important in terms of interpreting the results of the survey.

CONCLUSIONS

Roadside alcohol and drug surveys provide a wealth of information about the prevalence of alcohol and drug use among the general population of drivers who have not come to the attention of police through crash involvement or arrest. Surveys of this nature offer an opportunity to examine the extent of this risky behaviour, the circumstances under which it occurs, and the characteristics of those who are involved. The information is of tremendous value in the development and implementation of prevention, intervention, and enforcement programs. In addition, roadside surveys can be utilized to help evaluate the impact of countermeasure programs.

A roadside survey is a major effort that requires considerable forethought, planning, negotiations with key stakeholders and partners, and the development of a detailed protocol for the survey. It is an intensive effort that requires a tremendous amount of preparation. The key to a successful survey is planning and several months are required to ensure all the various elements are in place before a single driver is interviewed. These surveys have been done by researchers, governments and community groups with an interest in rates of impaired driving in their community.

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Drug driving law enforcement: Detection by screening of injured driver blood samples

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Abstract

Context
The contribution of drug driving to road trauma is well recognised. Jurisdictions around the world are investigating and implementing countermeasures to address drug driving related road trauma. In 2004, the Australian state of Victoria introduced legislation prohibiting the driving of a motor vehicle with the illicit drugs, cannabis (THC), methamphetamine (MA), methylenedioxymethamphetamine (MDMA) present. Police were given the authority to drug test drivers at the roadside to enforce this law. In addition to the roadside drug testing program, Victoria is now enforcing this law by routinely screening blood samples taken at hospitals from injured drivers.

Objectives
Victoria has enforced drink driving laws by compulsory blood sampling of injured drivers since 1974. This program has been successful in detecting and the prosecution of drink drivers to increase drink driving deterrence. In July 2009, the screening of compulsory blood samples taken from injured drivers was expanded to include screening for the presence of THC, MA and MDMA to detect and prosecute drug drivers to increase drug driving deterrence.

Key Outcomes
The implementation of this enforcement program has lead to identification and prosecution of drivers for drug driving offences that would have otherwise not been detected. In 2011, 9.5% of injured drivers were detected with one or more of the three target drugs present. In addition, a further 4.7% of injured drivers were detected with one or more of the three target drugs present in combination with alcohol.

Discussion and conclusions
The detection and prosecution of drug drivers through this enforcement program has identified a significant presence of the illicit drugs, THC, MA and MDMA, alone and in combination with alcohol. This enforcement program is an effective mechanism to detect and prosecute drug drivers to increase drug driving deterrence.

Introduction

Since the Parliamentary Road Safety Committee inquiry into the effects of drugs (other than alcohol) on road safety in the Australian state of Victoria made its recommendations in 1996 on actions to combat drug driving (Victorian Parliamentary Road Safety Committee, 1996), a series of drug driving countermeasures have been implemented in Victoria. This paper discusses the introduction of the enforcement of drug driving laws through the routine screening of blood samples taken at hospitals from injured drivers for the presence of illicit drugs.

Legislative Framework

Victoria has a long history of enforcement of laws enacted to reduce alcohol related road trauma. One of the elements of the enforcement framework is the detection of drink driving offenders by the routine screening of blood samples taken at hospitals from injured drivers for the presence of alcohol. This process has been used to prosecute drink drivers since 1974.

The process requires that all persons that present for medical examination or treatment following involvement in a collision must allow a sample of blood to be taken for analysis. It is an offence not to allow a sample to be taken and the taking of samples from unconscious persons without consent is authorised (Road Safety Act, 1986). The blood samples are analysed by an accredited forensic laboratory, the Victorian Institute of Forensic Medicine, and the analysis results are provided by the laboratory to the police. In cases where the sample analysis indicates an alcohol concentration above the legal limit is present, the driver is prosecuted for a drink driving offence.

In 2004, it became an offence in Victoria to drive a motor vehicle with the illicit drugs methamphetamine (MA) and cannabis, delta-9-tetrahydrocannabinol (THC), present (Road Safety (Drugs Driving) Act, 2003). Police were given the authority to enforce this law by randomly testing drivers for the presence of illicit drugs by oral fluid (saliva) sample screening at the roadside at the same time. In 2006, driving with 3, 4-methylenedioxymethamphetamine (MDMA) was also included to the list of illicit drugs (Road Safety (Drugs) Act, 2006). Over the period 2005 to 2008, 71,474 drivers were tested for the presence of illicit drugs at the roadside resulting in 1,254 (1.75 %) found to have one or more of the three target illicit drugs present (Boorman, 2010). The roadside drug testing enforcement activity has been found to be an effective process to detect drivers that drive a motor vehicle with illicit drugs present (Boorman and Owens, 2009).

In July 2009, the enforcement activity to detect and prosecute illicit drug using drivers was expanded to include the routine screening of blood samples taken at hospitals from injured drivers for the presence of illicit drugs as well as alcohol.

Key Outcomes

The screening of blood samples taken at hospitals in Victoria from injured drivers in 2011 suggests that a significant proportion of driver injured in collisions have alcohol or illicit drugs or a combination of both present. In 2011, a total of 2,929 injured driver blood samples were screened for the presence of alcohol and the three target illicit drugs, THC, MA and MDMA. Of the 2,929 samples, 30.9 % (n=907) were found to be positive to alcohol or illicit drugs or a combination of both. Of the 907 positive samples, 30.9 % (n=490) were found to have alcohol only present, 9.5 % (n=279) were found to have illicit drugs only present and 4.7 % (n=138) were found to have a combination of both alcohol and illicit drugs present (see Table 1).

Total	Negative		Positive		Alcohol Only		Drugs Only		Alcohol + Drugs	
2929	n=	%	n=	%	n=	%	n=	%	n=	%
	2022	69.1	907	30.9	490	16.7	279	9.5	138	4.7

Table 1: Prevalence of Alcohol and Illicit Drugs in Injured Drivers Blood Samples

Of the 279 samples found to have illicit drugs only present, 68.5 % (n=191) were found to have THC present (media concentration 5 ng/mL), 41.9 % (n=117) were found to have MA present (median concentration 0.10 mg/L) and 0.7 % (n=2) were found to have MDMA present (median concentration 0.14 mg/L). The age range of the drivers found to have illicit drugs only present was 17 years to 66 years with a median age of 29 years (see Table 2).

	Age Range	THC ng/mL	MA mg/L	MDMA mg/L
No.	279	191	117	2
%	-	68.5	41.9	0.7
Max	66	36	1.70	0.20
Min	17	2	0.03	0.08
Ave	32	8	0.22	0.14
Med	29	5	0.10	0.14

Table 2: Illicit Drug Only Samples – Prevalence by Drug Type

Of the 138 samples found to have a combination of alcohol and illicit drugs present, 21 samples contained alcohol at a concentration of less than 0.05 grams of alcohol per 100 millilitres of blood as well as one or more of the three target illicit drugs (median alcohol concentration 0.038 g/100mL). Of the 21 samples found to have an alcohol concentration of less than 0.05 grams of alcohol per 100 millilitres of blood, 95.2 % (n=20) were found to have THC present (media concentration 6 ng/mL) and 14.2 % (n=3) were found to have MA present (median concentration 0.09 mg/L). None of the 21 samples were found to contain MDMA. The age of the 21 drivers ranged from 19 years to 46 years with a median age of 34 years (see Table 3).

	Age Range	Alcohol g/100mL	THC ng/mL	MA mg/L	MDMA mg/L
No.	21	21	20	3	0
%	-	-	95.2	14.2	-
Max	46	0.049	22	0.20	-
Min	19	0.015	2	0.02	-
Ave	34	0.037	7	0.09	-
Med	34	0.038	6	0.09	-

Table 3: Alcohol < 0 .05 g/100mL in Combination with Illicit Drugs Samples

Of the 907 samples found to be positive to alcohol or illicit drugs or a combination of both, 66.9 % (n=607) were found to have only alcohol present or alcohol at a concentration at or above 0.05 grams of alcohol per 100 millilitres of blood in combination with illicit drugs. The remaining 33.1 % (n=300) of samples were found to have only illicit drugs present of illicit drugs in combination with and alcohol concentration of less than 0.05 grams of alcohol per 100 millilitres of blood (see Table 4).

All Positive		Alcohol Only and Drugs & Alcohol >.05		Drugs Only and Drugs & Alcohol <.05	
n=	%	n=	%	n=	n=
907	-	607	66.9	300	33.1

Table 4: Alcohol in Combination with Illicit Drugs Samples

Discussion

In Victoria it is an offence to drive a motor vehicle with an alcohol concentration at or above 0.05 grams of alcohol per 100 millilitres of blood. A zero alcohol concentration applies to special vehicle and licence categories, for example, large transport vehicles and novice drivers. The enforcement of drink driving law through the routine screening injured driver blood samples has successfully operated alongside high volume breath alcohol screening to detect and prosecute drink drivers for almost 40 years. Of the 2,229 injured drivers screened for the presence of alcohol and illicit drugs in 2011, 20.7 % (n=607) were found to have a blood alcohol concentration at or above the 0.05 legal limit. On the face of it, these drivers have committed a drink driving offence and are subject to prosecution regardless of the whether illicit drugs were present.

The introduction of the routine screening of injured driver blood samples for the presence of the illicit drugs THC, MA and MDMA, in 2009 has provided a further dimension to the detection and prosecution if drink and drug using drivers. Of the 2,929 injured drivers screened for the presence of alcohol and illicit drugs in 2011, 9.5 % (n=279) were found to have one or more of the three target illicit drugs present and no alcohol present. A further 21 drivers (0.7 %) were detected with one or more of the three target drugs present and an alcohol concentration of less than the 0.05 legal limit. On the face of it, these drivers have committed a drug driving offence and are subject to prosecution.

As a result of the implementation routine screening of injured driver blood samples for the presence of the illicit drugs, 300 illicit drug using drivers have been detected and are subject to prosecution that would not otherwise have been detected. The detection of an additional 300 offenders is just under a 50 % increase in number of offenders detected through the routine screening of injured driver blood samples in 2011.

Conclusion

The detection of illicit drug using drivers through the routine screening of blood samples taken at hospitals from injured drivers suggests the presence of illicit drugs in drivers involved in road trauma in Victoria is significant. Moreover, the identification of the drivers found to have illicit drugs present, alone and in combination with alcohol in 2011, indicates the routine blood sample screening process is an effective mechanism to detect and prosecute drug drivers to increase drug driving deterrence.

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Best practice in random breath testing and cost-effective intensity levels

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Abstract

Background
Random breath testing (RBT) aimed at general deterrence of drink-driving has been shown to be more effective than targeted alcohol screening from patrol cars aimed at apprehending drink-drivers. The European PEPPER study's meta-analysis of 40 evaluations found that the largest crash reductions were achieved by Australian methods of RBT (involving use of high-visibility bus-based testing stations as well as car-based operations and supported by mass-media publicity) compared with other countries.

Aim
This paper aims to summarise the characteristics of Australian RBT that make it best practice.

Method
Extensive research has been conducted since RBT was first introduced in Victoria in July 1976 and subsequently in other States. Research linking the intensity of RBT with reductions in serious alcohol-related crashes is summarised in the paper.

Results
General deterrence through the perceived risk of detection is maximised by operations that appear to cover broad areas and both minor and major roads, achieve at least 20 hours per 100 square kilometres per week in urban areas, are highly visible and test a substantial proportion of passing motorists. Car-based RBT should be preferred in rural areas, covering also minor roads that may be used in evasion strategies, and bus-based RBT stations should only be operated in conjunction with car-based RBT placed on alternative roads. Diminishing-returns type relationships between the intensity of RBT and reductions in serious alcohol-related crashes have been calibrated. It was found that breath testing rates per licensed driver could be increased to at least 1.5 per year before cost-effectiveness is in doubt.

Discussion and conclusions
RBT is remarkably effective in providing general deterrence of drink-driving and should be preferred over operations aimed principally at apprehending drink-drivers. Characteristics of RBT operations that maximise effectiveness have been identified. While labour-intensive, RBT is so effective that testing rates per licensed driver can be increased to high levels and still justify their cost by the savings in road trauma.

Background and effectiveness of different methods of drink driving enforcement

There are many studies indicating the effectiveness of random breath testing in reducing fatal and serious injury crashes, especially those crashes likely to involve illegal BAC. Erke et al (2009) conducted a meta-analysis of 40 good quality studies and found that crashes involving alcohol were reduced by 17% at a minimum and that all crashes, independent of alcohol involvement, were reduced by about 10–15%. Larger crash reductions were found due to Australian methods of RBT (involving use of high-visibility bus-based testing and supported by mass media publicity) compared with alcohol checkpoints in other countries.

An alternative to random breath testing is alcohol screening testing by car-based operations upon interception of a driver and/or at targeted locations and times based on an intelligence strategy about the likelihood of encountering illegal drink-drivers. This type of operation can be contrasted with large-scale, wide-spread RBT, with many tests conducted from high-visibility, bus-based checkpoints.

A comparative review of drink-driving enforcement measures conducted as part of the European PEPPER project (Erke et al 2008) considered the effectiveness of DUI ("Driving Under the Influence") patrolling aimed at apprehending drink-drivers, and the effectiveness of DUI-checkpoints (of which Australian RBT is a classical type). The subset of 11 evaluations with good study design showed that DUI patrolling reduced casualty crashes by 6% and there was no statistically significant reduction in fatal crashes.

The same review found that 73 evaluations with good study design showed that DUI-checkpoints reduced casualty crashes by 10% and fatal crashes by 17% (both effects were statistically significant). The effect on casualty crashes was almost doubled when the checkpoints were supported by paid media publicity about drink-driving.

Best practice in random breath testing

Best practice recommendations for RBT by Harrison et al (2003) included:

- High visibility RBT, designed to produce general deterrence, also needs to be complemented by mobile operations that discourage drivers from attempting to evade RBT by using back streets. Such mobile operations, however, must remain a complement to high visibility RBT and not the sole method of enforcement.
- Covert operations in rural towns could be conducted in conjunction with the overt enforcement ... to increase the perceived link between visible enforcement and detection.

Best practice recommendations by Wundersitz and Wooley (2008) included:

- To alter motorists behaviour for the rest of the evening and avoiding drink driving episodes altogether, RBT should continue to operate earlier in the evening (e.g. 6pm to 10pm) and preferably near drinking establishments.
- RBT operations are also required later in the evening (e.g. midnight to 2am) when most drink driving occurs for general and specific deterrence.

Best practice recommendations from Delaney et al (2006) and Cameron et al (2012) included:

- RBT in urban areas should be conducted for at least 20 hours per 100 square kilometres per week to exceed the minimum level of exposure intensity that research indicates is necessary to achieve crash reductions in the area.
- Scheduling of RBT in urban areas should make use of the residual effect of at least two weeks and not necessarily return to the same testing area within two weeks.
- RBT operations should be very overt, including high visibility and testing a substantial proportion of passing motorists. However, maximising the number of tests should not be at the expense of covering broad urban areas and achieving the minimum testing hours per unit area.

- Car-based RBT should be used in urban areas in conjunction with bus-based RBT in order to provide a broader coverage of the metropolitan road system for a greater number of hours per week and hence achieve a general deterrence effect. Car-based RBT should also be conducted on sub-arterial roads and residential streets where it is perceived that bus-based RBT is not operated.
- Car-based RBT should be preferred in rural areas, covering both minor and major roads. If bus-based RBT is operated in rural areas, they should not operate alone and should undertake RBT in conjunction with car-based RBT on alternative roads.
- Targeted alcohol screening testing should principally aim to apprehend drink-drivers with very elevated BACs and should not be seen as a substitute for RBT in contributing to the total number of preliminary breath tests conducted.

Research on levels of RBT and effects on crashes

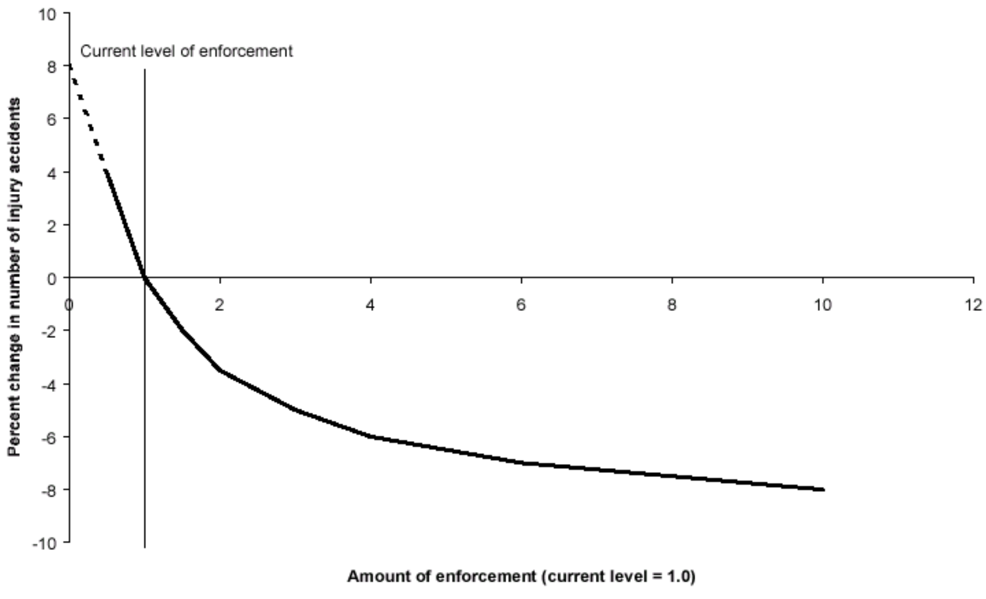
There is general agreement that "diminishing returns" apply to levels of traffic enforcement, i.e. the road trauma reduction resulting from an increase in enforcement diminishes as the level of enforcement increases. Elvik (2001) concluded that the relationship is of the form shown in Figure 1. Diminishing returns relationships have been found to apply to levels of RBT (Henstridge et al 1997, Koornstra et al 2002, Elliott and Broughton 2005).

Elvik (2001) proposed a number of potential functional forms for the relationship shown in Figure 1, including the power function:

$$Y = A \,.\, X^B$$

where Y is the number of casualty crashes, X is the level of enforcement, and A and B are parameters related to the shape and level of the relationship. B is usually negative, i.e. indicating that a given increase in enforcement from its current level leads to a lower level of crashes. Among economists, B is known as the "elasticity" of the relationship between X and Y. It measures the percentage change (reduction) in the level of crashes for a 1% increase in the level of enforcement. It is a useful summary measure of diminishing returns relationships.

Figure 1: Relationship between traffic enforcement and crashes identified by Elvik (2001)



Numerous studies have been conducted on the crash reduction benefits of RBT (Delaney et al 2006, Erke et al 2009), but apart from those carried out in Victoria during the early years of RBT, suggesting minimum levels of intensity needed (Cameron and Sanderson 1982), only a few have examined the relationship between levels of RBT and crashes, as follows.

Victoria

During 1990-1993, immediately after RBT was escalated in Victoria using bus-based testing stations, Newstead et al (1995) found that the monthly number of tests at buses was associated with reductions in "high alcohol hour" (HAH) serious casualty crashes in Melbourne. The analysis fitted a relationship of the power function form described above and found that the elasticity between tests and the crashes was -0.0186.

A subsequent analysis during 1990-1996 was unable to separate the effects of the bus-based random breath tests and intensive mass-media drink-driving publicity because of their high correlation, but found that the monthly activity level of this drink-driving program was associated with elasticities of -0.0204 for Melbourne HAH serious casualty crashes and -0.0155 in the rest of Victoria (Newstead et al 1998).

An improved methodology ("state-space" time series modelling) was used to examine the associations between monthly casualty crashes and monthly random breath tests (both bus- and car-based), together with other enforcement and influential factors (Diamantopoulou et al 2000). The crashes during HAH and low alcohol hours (LAH) were modelled separately in each of the five Police regions over the period 1989-1997. These analyses found associations between the number of tests and casualty crash reductions in every Police region, in either HAHs or LAHs or both, and sometimes in the month following that in which the tests were conducted. The elasticities were all of the same magnitude, ranging from -0.096 to -0.191. These estimated elasticities were typically larger than those found by Newstead et al (1995, 1998) and will reflect the greater reliability inherent in the improved methodology.

New South Wales

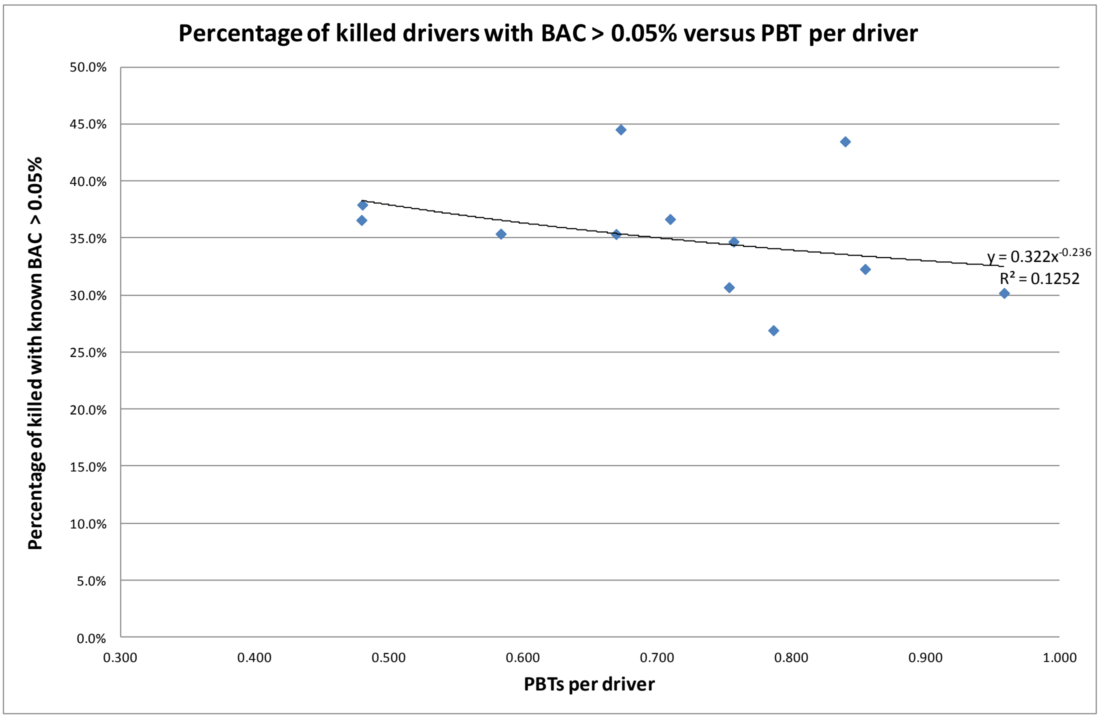
Henstridge et al (1997) examined the association between daily levels of random breath tests and serious crash time series in New South Wales. Crashes during the period 1976 to 1992 were analysed, which included the high-profile introduction of RBT in December 1982.

Very satisfactory models were found which seemed to capture the association between RBT and serious crashes. The analysis confirmed that diminishing returns-type relationships apply to levels of RBT. It found that a 10% increase in the current testing levels was associated with a 3.5% reduction in serious casualty crashes, suggesting an elasticity of -0.35.

Recent analysis in another Australian State

Similar relationships between levels of RBT and the involvement of illegal BAC levels in killed drivers have continued to apply during recent years. Figure 2 shows the relationship between annual PBTs (preliminary breath tests, 90% of which were RBTs) per licensed driver and the percentage of killed drivers over 0.05% BAC in an Australian State in which the level of drink-driving enforcement has changed substantially during the years 1999 to 2011.

Figure 2: Correlation between PBTs per licensed driver and BAC of killed drivers



The estimated elasticity between annual PBTs per driver and the percentage killed with BAC over 0.05% was -0.236. Further analysis found that the relationship was even stronger for killed drivers with BAC above 0.15%, with estimated elasticity of -0.371 between them.

Economic analysis of levels of RBT

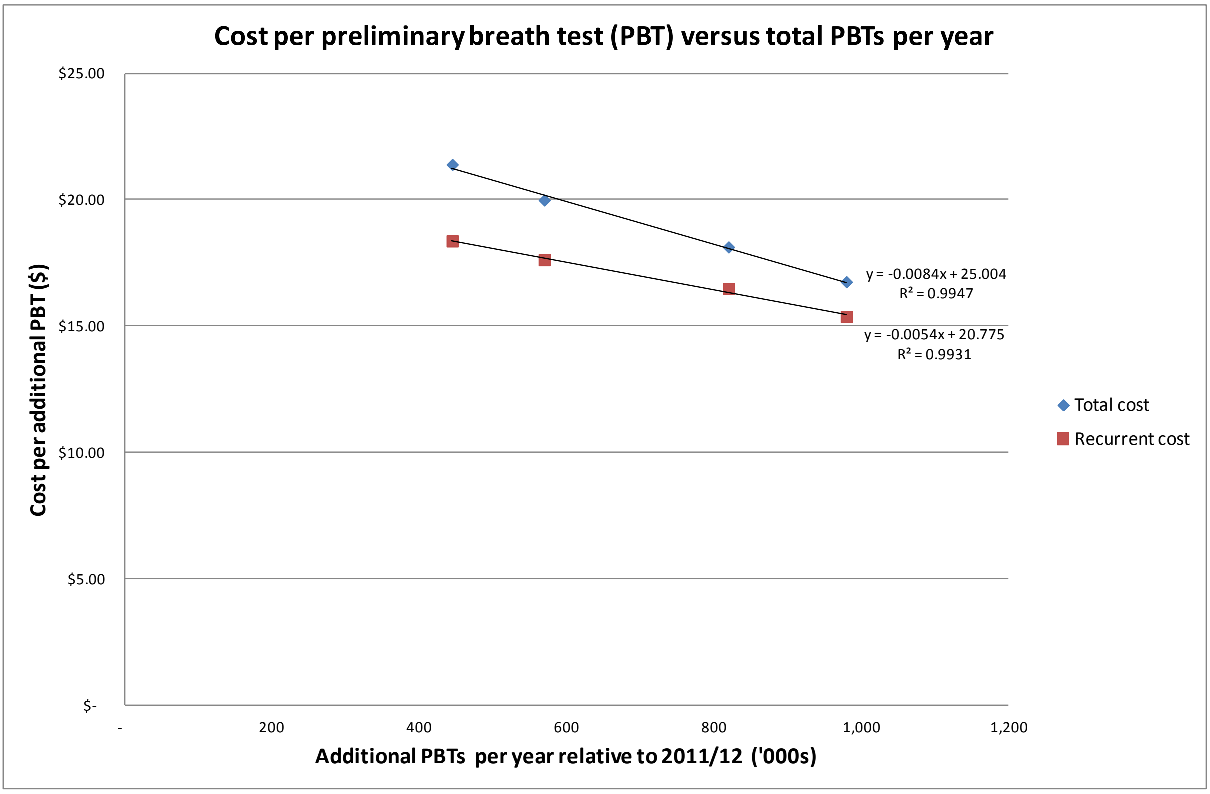
The economic analysis estimated the value of the savings in road trauma victims from increased drink-driving enforcement and compared that with the cost of providing the additional enforcement. Based on Elvik (2001) and the findings from analysis in Victoria and NSW, it was assumed that a diminishing returns relationship with the power function form applies to estimate the reduction in victims at each level of enforcement. The fitted function shown in Figure 2 calibrated the appropriate power function, with the key parameter being the estimated elasticity between the PBT level and killed drivers with BAC over 0.05%. Under the assumption of a given functional form, the function fitting process served the role of calibration rather than the more onerous role of establishing that a relationship exists.

Costs of additional breath tests

In the same State shown in Figure 2, the cost of increased PBTs (principally increased RBT) to various annual levels of total testing had been calculated by the Police. The annual recurrent cost included personnel-related costs, test bus operating costs, patrol car lease and operating costs, disposable equipment costs, and depreciation costs. The unit recurrent cost per PBT at each level of increase in annual PBTs from the current level is shown in Figure 3. It can be seen that there are economies of scale associated with the cost per test.

The substantial capital cost of each bus was amortised over its effective life to estimate the annual cost of the buses to add to the total recurrent cost. The unit total cost per PBT (recurrent plus amortised bus cost) is also shown in Figure 3. The cost per PBT was fixed at $16.75 for increases in total PBTs beyond the range shown in Figure 3.

Figure 3: Unit costs of additional preliminary breath tests



Valuation of road trauma savings due to increased enforcement

The unit social cost, using the "willingness to pay" method, was used to value the savings in all victims involved in fatal crashes with killed drivers who have BAC above 0.05%. The value assigned to each killed driver was $6.657 million (in 2010-2011), based on NSW Roads and Traffic Authority (2008) estimates. This value was supplemented by the unit costs reflecting the injury profile of all victims involved in crashes with killed alcohol-impaired drivers during 2010 and 2011. The unit social cost of each crash involving a killed driver with BAC above 0.05% was estimated to be $7.381 million in 2010-2011.

Savings in driver fatalities and crash costs compared with the cost of additional tests

From a base level of 0.485 PBTs per licensed driver in the specific State, the function in Figure 2 was used to estimate the proportion of driver fatalities with illegal BAC at each testing level, the number and percentage of driver fatalities saved, and the saving in social costs of the road trauma to all victims in the fatal crashes involving the saved drivers (Table 1). This was compared with the cost of providing the additional PBTs in the State based on the unit total cost per PBT shown in Figure 3. The benefit-cost ratio (BCR) at each level of the expanded program (measured by the PBT rate per licensed driver) was calculated by dividing the annual saving in social costs of the crashes by the annual cost of the additional PBTs. The marginal BCR was calculated from the incremental social cost saving due to 10,000 increase in PBTs and the increment in the program cost of the extra 10,000 PBTs.

Table 1: Economic analysis of reduction in driver fatalities with BAC over 0.05% due to increased PBTs (90% random breath tests) per licensed driver

PBTs per licensed driver per annum	Estimated proportion of driver fatalities with BAC > 0.05%	Fatalities saved per annum (above base level)	Percentage of total driver fatalities saved	Social cost of fatal crashes saved p.a. ($000s)	Cost of additional PBTs p.a. ($000s)	Expanded program BCR (above base level)	Marginal BCR
0.485	**0.382**	0.00	0.00%	0	-	NA	NA
0.622	0.360	4.42	3.40%	32,614	5,087	6.41	5.81
0.747	0.345	7.33	5.64%	54,076	9,006	6.00	5.24
0.871	0.333	9.59	7.38%	70,797	12,253	5.78	5.13
0.996	0.322	11.43	8.79%	84,330	14,828	5.69	5.47
1.120	0.313	12.95	9.96%	95,595	17,085	5.60	3.10
1.245	0.306	14.25	10.96%	105,176	20,435	5.15	2.66
1.369	0.299	15.37	11.83%	113,465	23,785	4.77	2.32
1.494	0.293	16.36	12.58%	120,736	27,135	4.45	2.05
1.618	0.287	17.23	13.26%	127,188	30,485	4.17	1.82
1.743	0.282	18.02	13.86%	132,969	33,835	3.93	1.64
1.867	0.278	18.72	14.40%	138,190	37,185	3.72	1.49
1.991	0.274	19.37	14.90%	142,940	40,535	3.53	1.36

In the specific State analysed, there is uncertainty about the continuation of the fitted function in Figure 2 beyond about one PBT per licensed driver per annum and also uncertainty in the unit cost per PBT at that level (though likely to be decreasing). For this reason the estimates of the program and marginal BCRs at higher levels of testing should be treated with caution, and only BCRs of at least two accepted as an indicator of a cost-beneficial investment in PBT. On this basis, the marginal BCRs in Table 1 suggest that up to 1.5 breath tests per licensed driver per year could invested before the cost-benefit of a drink-driving enforcement program of this magnitude (90% random breath tests) is in doubt.

Conclusion

RBT is remarkably effective in providing general deterrence of drink-driving and should be preferred over operations aimed principally at apprehending drink-drivers. Characteristics of RBT operations that maximise effectiveness have been identified. While labour-intensive, RBT is so effective that testing rates per licensed driver can be increased to high levels and still justify their cost by the savings in road trauma.

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Random drug testing in Australia, analogies with RBT, and likely effects with increased intensity levels

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Abstract

Background
Roadside oral fluid tests (ROFTs) of proscribed impairing drugs are now common practice in all Australian jurisdictions to detect and deter drug-driving. These tests are usually performed at bus-based random breath test (RBT) stations, thus providing a suitable environment for the secondary oral fluid test (if necessary) and safe storage of saliva samples. While not all randomly-selected drivers are required to provide an initial oral fluid test, usually following a preliminary breath alcohol test, the process of conducting ROFTs in conjunction with RBT results in what is essentially random drug testing (RDT).

Aim
This paper aims to develop an analogy between RDT and the early years of RBT in Australia when intensity levels were low. This analogy is used to predict the likely effects on drug-driving among killed drivers as the number of random drug tests is increased.

Method
Relationships between the annual number of RDTs conducted in Victoria during 2005 to 2009 and the percentage of killed drivers with drugs in their blood stream (either a proscribed drug [THC, MA or MDMA] or any impairing drug) were able to be calibrated. The calibrated relationships were then used in conjunction with an estimate of the cost per random drug test to determine the cost-effectiveness of RDT.

Results
Diminishing-returns type relationships were found between the annual number of RDTs and the presence of impairing drugs in killed drivers. Although the ROFT equipment and associated Police testing time is currently expensive per test, the calibrated relationships suggested that current RDT rates per licensed driver could be increased to at least 10% per year before cost-effectiveness is in doubt.

Discussion and conclusions
RDT has the potential to achieve significant general deterrence of drug-driving in a similar way as that achieved by best-practice RBT. While RDT is highly cost-effective at the modest levels of intensity that it is currently operated at in Australia, the analogy with RBT developed in this paper suggests that it will remain cost-effective if testing rates per licensed driver are increased up to 10% of drivers per year. However, to remain cost-effective at even higher testing rates per year, the cost per random drug test must be substantially decreased.

Background to the drug driving problem

There are numerous drugs, both licit and illicit, that are thought to impair driving alone and in combination (including combined with alcohol) and are associated with increased risk of road crashes and trauma. Unlike alcohol in the driver's blood stream, whose effects on driving increase with blood alcohol concentration, the mere presence of some drugs is impairing and the effect is not necessarily immediate or when the drug concentration is at its highest.

The presence of each drug has been measured among driver casualties (killed and/or injured) and among drivers on the road, in various years and in various jurisdictions. However, because of the rapidly changing availability and consumption patterns of illicit drugs, and prescription patterns of therapeutic drugs, their presence among drivers varies rapidly with geography and time.

However, the comparison of drug presence rates among driver casualties and among drivers on the road provides valuable information about the relative risks of road crashes associated with specific drugs and drug combinations. Australian crash-based studies have estimated the relative risks associated with various drugs, drug combinations and alcohol, albeit using a different basis for measuring drug presence among on-road drivers ("culpability analysis"). The estimated crash risks associated with each drug or drug combination may be relatively immune from the changing patterns of licit and illicit drug consumption.

Incidence of drugs among driver casualties in Australia

Drummer et al (2003) examined trends in the incidence of drugs and alcohol presence among 3398 killed drivers in Victoria, NSW and WA during 1990-1999. During the period, there was a trend for reducing presence of BAC over 0.05% and for increasing presence of impairing drugs (rising from 20% to 27%) in killed drivers. Over the full decade, the most common impairing drugs were cannabis (13.5%, of which THC 8.5%), opioids (4.9%), stimulants (4.1%), benzodiazepines (4.1%) and other psychotropic drugs (2.1%). This same data was the subject of culpability analysis described below (Drummer et al 2004).

Incidence of drugs among drivers on the road in Australia

Davey and Freeman (2009) screened oral fluid samples from 2657 drivers stopped at RBT stations in urban and rural areas of Queensland during 2006-2007. They detected 3.8% of the sample with one or more illicit drugs, of which the most common drugs were MDMA (1.99%), THC (1.73%), amphetamines (0.86%) and cocaine (0.22%). The drink driving detection rate was only 0.8%, suggesting that drug driving was much more common than drink driving in Queensland.

Chu et al (2012) measured drugs present in 853 roadside oral fluid tests from Victorian drivers found positive on drug screening tests during 2009/10. At least one proscribed drug was present in 96% of drivers, and the most common were MA (77%), THC (42%), MDMA (17%) and all three combined (4%). Other drugs detected were opioids (14%), cocaine (8%, often combined with MA), and benzodiazepines (8%). Combinations of drugs were common.

Risks associated with drugs present in drivers

Collecting information on drugs present in drivers on the road in a way that is directly comparable with information on drugs present in driver casualties in the same jurisdiction and time period is very difficult and expensive. For this reason, estimates of crash risk in Australia have relied on methods of culpability analysis. In this approach, the distribution of drug presence in drivers considered non-culpable (or not responsible) for a crash is considered to represent the distribution of drugs among all drivers on the road. Analysis comparing the distributions of drug presence among the culpable and non-culpable drivers allows the ratio of the odds of crashing for the culpable driver relative to the non-culpable driver to be estimated. This is known as the Odds Ratio (OR) and is close to representing the relative risk of crashing for the drug-affected driver relative to a drug-free driver.

Risk of fatality associated with drugs in Australian drivers

Drummer (1994) was one of the first to use methods for assigning culpability or responsibility for each crash after he collected crash details for 1045 killed drivers. Culpability was determined according to mitigating factors (independent of drug analysis), and drivers were classified as culpable, contributory, or not culpable. The mitigating factors used in the analyses were the condition of the road and vehicle, driving conditions, type of accident, witness observations, road law obedience, difficulty of the task involved, and level of fatigue (Robertson & Drummer, 1994). The proportion of culpable drivers was calculated for each drug type condition. The large majority (73%) of drivers in the sample as a whole were culpable, while 18% were not culpable. The relative risks for each drug type and drug combination were estimated by the Odds Ratio (OR) described above.

Alcohol was the most prevalent drug found in these killed drivers (36%). The highest OR for any drug alone was found for alcohol (6.0), then opiates (2.3). ORs were considerably higher for the following drugs when present in combination with alcohol: benzodiazepines (9.5), stimulants (8.7) and cannabis (5.6).

Drummer et al's (2003) data on 3398 drivers killed during 1990-1999 were subjected to culpability analyses in a subsequent publication, and ORs were calculated for various drug combinations (Drummer et al 2004). The presence of THC was associated with increased crash risk for both car drivers (OR 2.7) and motorcyclists (OR 2.4). Of those drivers positive for THC only, the majority (84%) had THC levels > 5 ng/ml. THC > 5 ng/ml was significantly associated with increased culpability (OR 6.6), which was similar to the OR associated with BAC positive cases over 0.05%. Drivers positive for THC and who had a BAC over 0.05% were 2.9 times more likely to be culpable than drivers who were BAC positive only, which suggests that THC does enhance impairment associated with alcohol.

Risk of serious injury associated with drugs in Australian drivers

Blood samples were collected from 2500 non-fatally injured drivers in South Australia in 1995-1996 (Longo et al, 2000a, b). Alcohol was the most prevalent drug in these samples, being present in 8.6% of cases. The next most prevalent drugs were cannabis (THC) alone (7.1%), cannabis and alcohol (3.0%), benzodiazepines only (1.8%), and stimulants alone (0.8%). As for the risk of a fatal crash, alcohol was the most dangerous drug in terms of the percentage of injured drivers found culpable with one drug alone. Culpability was increased for drugs in combination with alcohol. Culpability analysis suggested that there were significantly increased injury crash risks associated with combinations of THC and alcohol (OR 5.4), benzodiazepines and alcohol (OR 13.4), and benzodiazepines alone (OR 2.0).

Ogden et al (2011) obtained blood samples taken from drivers presenting at hospitals in Victoria. Commencing December 2008, the samples of 1801 injured drivers were screened for alcohol and drug presence, and subjected to culpability analysis in the same way as Drummer et al (2004). The analysis suggested that serious injury crash risk increases with the number of drugs present compared with a drug-free driver: one drug (OR 4.5), two (OR 11.4), three (OR 37.5), four or more (higher OR, but indeterminate). Very high risks associated with alcohol in combination with THC (OR 62.0) or with benzodiazepines (OR 20.2) were confirmed. High risks were associated with benzodiazepines alone (OR 3.1), benzodiazepines in combination with other drugs (OR 8.9), and even higher for the benzodiazepines, other drugs and alcohol combination (OR 27.0). Ogden et al's (2010) earlier analysis of the first 837 injured drivers had found high risks associated with MA (OR 5.4) and MDMA (OR 5.1).

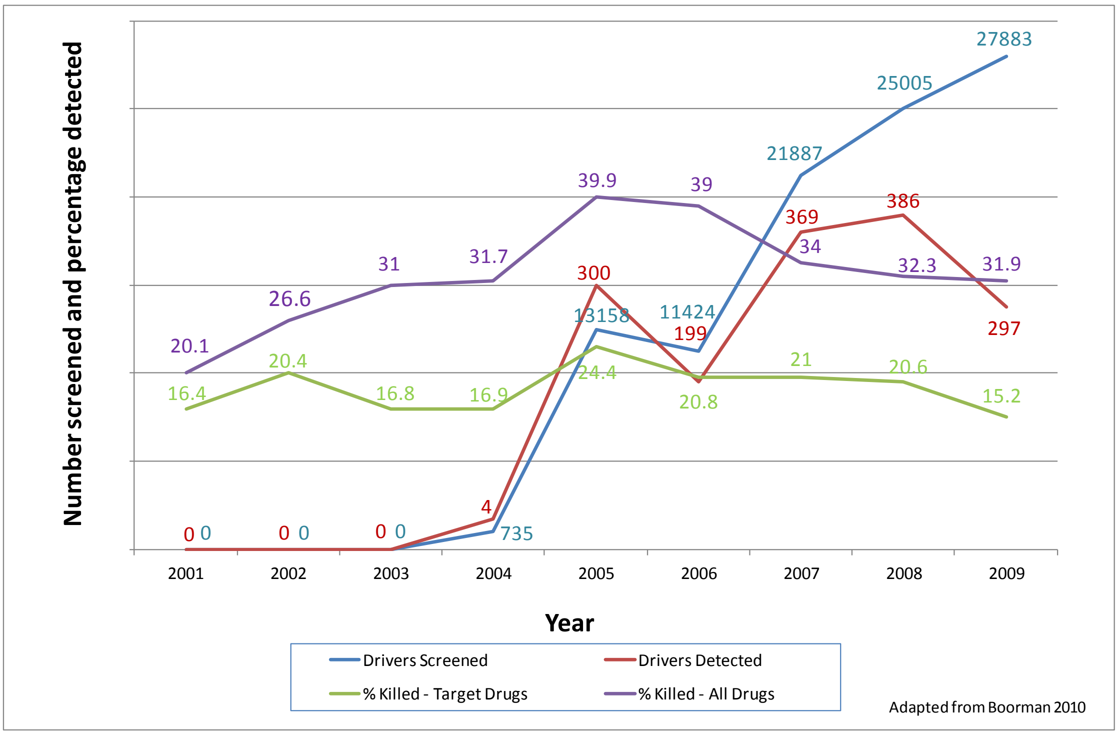
Roadside oral fluid tests for drug enforcement

An important development in drug driving enforcement in Australia was the introduction of legislation allowing roadside oral fluid testing (ROFT) and its potential use to randomly test drivers in a similar way to RBT. Victoria was the first State and apparently worldwide to enact such legislation in December 2004. Since its inception, over 100,000 drivers have been screened for drugs on the roadside in Victoria. All Australian States and Territories now conduct similar testing to Victoria (Boorman and Owens 2010, Chu et al 2012). Random ROFT is known as “random drug testing” (RDT).

The Victorian legislation initially allowed for random ROFT of only MA and THC. New legislation added MDMA to the framework in September 2006. Drivers are initially tested at the roadside by a tongue swipe using the Securetec Drugwipe TWIN. If this test is positive to one or more of the proscribed drugs, oral fluid is collected from the driver and tested using a second device, the Cozart Rapiscan. If this test is also positive, the driver is banned from driving for 24 hours and an oral fluid sample is sent for confirmation by laboratory analysis. Where the driver is unable to provide sufficient oral fluid, he or she is required to provide a blood sample for laboratory analysis. It is understood that very similar procedures and drug screening devices are used for RDT in the other Australian jurisdictions.

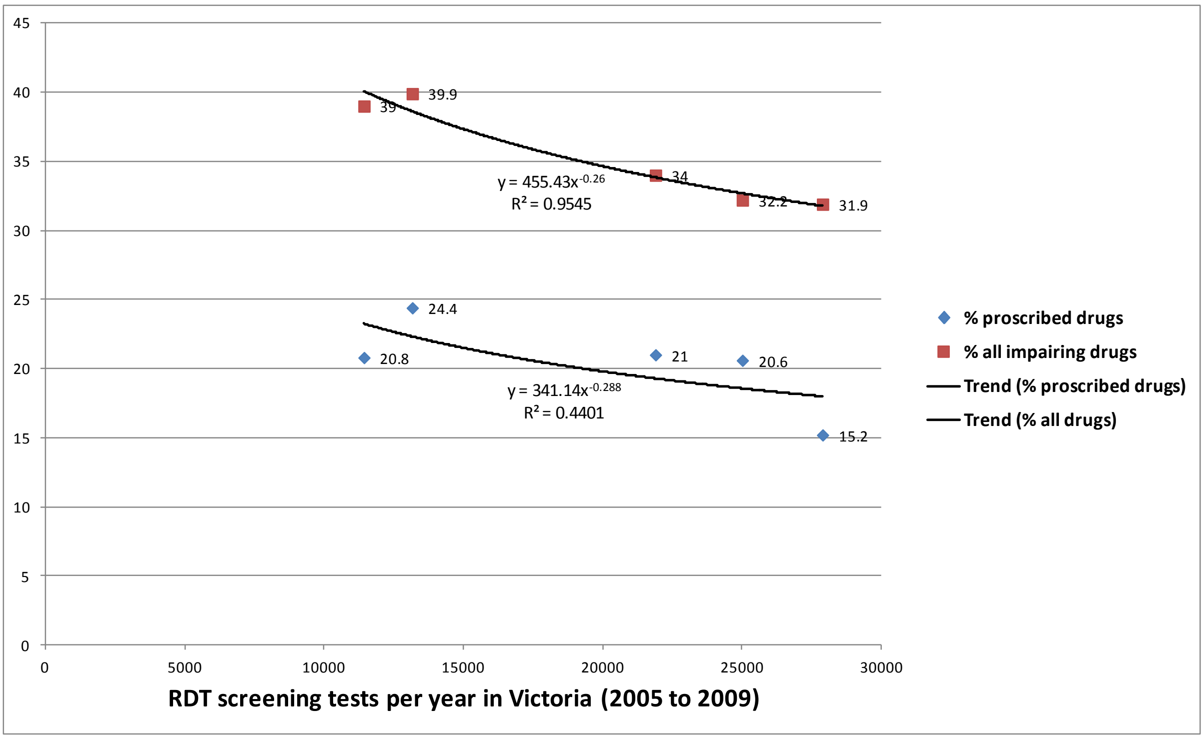
The number of drivers screened by RDT in Victoria has increased each year from 13,158 in 2005 to 27,883 in 2009. The detection rate of proscribed drugs fell from 2.3% to 1.0% during the same years (Boorman 2010). Figure 1 shows that the percentage of killed drivers found to have an impairing drug in their blood has fallen during the same period. Figure 1 also shows that the percentage of killed drivers with drugs present generally increased during 2001 to 2005. A reversal of that trend was associated with the increase in RDT.

Figure 1: Trends in percentage of killed drivers with target drugs (THC, MA or MDMA), or any impairing drug, versus number of drivers screened and detected at RDT in Victoria



The relationship between the annual number of ROFTs and the annual percentage of killed drivers with at least one of the proscribed drugs is shown in Figure 2. An even stronger relationship is apparent between the number of ROFTs and the percentage of killed drivers with any impairing drug (including the three proscribed drugs). This suggests an association between random drug testing (RDT) and the deterrence of both proscribed and non-proscribed impairing drugs taken by drivers.

Figure 2: Relationships between percentage of killed drivers with proscribed drugs, or any impairing drug, versus number of drivers screened by ROFTs at RDT in Victoria



Analogy with RBT

These types of "diminishing returns" relationships have been found to apply to levels of traffic enforcement generally (Elvik 2001) and to random breath testing (RBT) in particular (Henstridge et al 1997, Koornstra et al 2002, Elliott and Broughton 2005, Cameron 2013). Most ROFTs in Victoria were carried out at bus-based testing stations (Drug/Booze Buses) in conjunction with RBT and usually following an initial preliminary breath alcohol test. The strategic principle behind this type of operation was general deterrence of drug-driving, i.e. to raise the perceived risk of an illegal drug-driver being caught for this offence, not necessarily to detect illegal drug-driving on a larger scale that could be achieved by targeted drug-driving enforcement operations. This is the same strategic principle as applied to RBT in Australia.

For the above reasons, it was concluded that there is a reasonable analogy between RDT and RBT. From this, it was considered appropriate to use the relationships illustrated in Figure 2 to predict the likely effects on driver fatalities as RDT levels are increased. This approach has precedents in the economic analysis of the effects of RBT and other drink-driving enforcement operations on their cost-effective levels (Cameron 2008, 2013; Elvik et al 2012).

Economic analysis of levels of RDT

The economic analysis estimated the value of the savings in road trauma victims from increased drug-driving enforcement and compared that with the cost of providing the additional enforcement. Based on Elvik (2001) and the findings from Victoria in Figure 2, it was assumed that a diminishing returns relationship with the power function form applies to estimate the reduction in killed drivers with impairing drugs at each level of RDT.

Costs of additional roadside oral fluid tests (ROFTs)

Recent analysis (Cameron 2013) in an Australian State had estimated a unit cost of $18.37 to conduct a preliminary breath test (PBT) at a bus-based testing station where ROFTs are also administered to a sub-sample of drivers. The initial Securatec ROFT device returns a result in six minutes (Woolley and Baldock 2009), during which the officer must remain with the driver. If this test is positive (6.2% of tests), the driver is given the Cozart test which may take up to 30 minutes, at least part of which must be attended by the initial testing officer. In contrast, a PBT can take one minute if negative.

It was estimated that the testing cost per ROFT is about five times the cost per PBT, namely 5 times $18.37 equals $91.84 per ROFT. To this unit cost must be added the equipment costs of a Securatec preliminary tester ($38.00), a Cozart secondary tester ($41.40) applicable in 6.2% of ROFTs, and oral fluid sample analysis at a central laboratory ($200) applicable in 5.4% of ROFTs. In total, it was estimated that the average cost per ROFT is $143.28 per test.

Valuation of road trauma savings due to increased enforcement

The unit social cost, using the “willingness to pay” method, was used to value the savings in all victims involved in fatal crashes with killed drivers who had impairing drugs in their blood stream. The value assigned to each killed driver was $6.657 million (in 2010-2011), based on NSW Roads and Traffic Authority (2008) estimates. This value was supplemented by the unit costs reflecting the injury profile of all victims involved in crashes with killed drug-impaired drivers during 2010 and 2011. The unit social cost of each crash involving a killed driver with impairing drugs was estimated to be $7.532 million in 2010-2011.

Savings in driver fatalities and crash costs compared with the cost of additional tests

From a base level of 0.54 ROFTs per 100 licensed drivers in the specific Australian State, the function in Figure 2 was used to estimate the proportion of driver fatalities with impairing drugs at each drug testing level, the number and percentage of driver fatalities saved, and the saving in social costs of the road trauma to all victims in the fatal crashes involving the saved drivers (Table 1). This was compared with the cost of providing the additional ROFTs in the State based on the unit total cost per ROFT of $143.28. The benefit-cost ratio (BCR) at each level of the expanded program (measured by the ROFT rate per licensed driver) was calculated by dividing the annual saving in social costs of the crashes by the annual cost of the additional ROFTs. The marginal BCR was calculated from the incremental social cost saving due to 1,000 increase in ROFTs per annum and the increment in the program cost of the extra 1,000 ROFTs.

Table 1 indicates that RDT is highly cost-effective at current modest levels of testing (about 1.2% of licensed drivers per annum in Victoria). There is uncertainty about the extrapolation of the fitted function in Figure 2 to the higher levels of ROFTs per annum. For this reason the estimates of the program and marginal BCRs at higher levels of testing should be treated with caution, and only BCRs of at least two accepted as an indicator of a cost-beneficial investment in RDT. On this basis, the marginal BCRs in Table 1 suggest that a ROFT testing rate of up to 10% of licensed drivers per year could invested before the cost-benefit of a drug-driving enforcement program of this magnitude is in doubt.

Table 1: Economic analysis of reduction in driver fatalities with impairing drugs (including proscribed drugs, THC, MA and MDMA) due to increased ROFTs per year

ROFTs per licensed driver per annum (%)	Estimated proportion of driver fatalities with impairing drug(s)	Fatalities saved per annum (above base level)	Percentage of total driver fatalities saved	Social cost of fatal crashes saved p.a. ($000s)	Cost of additional ROFTs p.a. ($000s)	Expanded program BCR (above base level)	Marginal BCR
0.54%	**0.480**	0.0	0.0%	0	-	NA	NA
1.24%	0.386	19.8	15.2%	149,217	1,623	91.97	49.28
2.49%	0.322	30.2	23.2%	227,142	4,488	50.61	16.53
3.73%	0.290	34.7	26.7%	261,291	7,354	35.53	8.98
4.98%	0.269	37.4	28.8%	281,818	10,219	27.58	5.88
6.22%	0.254	39.3	30.2%	295,995	13,085	22.62	4.25
7.47%	0.242	40.7	31.3%	306,593	15,951	19.22	3.27
8.71%	0.233	41.8	32.2%	314,932	18,816	16.74	2.62
9.96%	0.225	42.7	32.9%	321,734	21,682	14.84	2.17
11.20%	0.218	43.5	33.4%	327,431	24,547	13.34	1.84
12.45%	0.212	44.1	33.9%	332,302	27,413	12.12	1.58

Conclusion

RDT has the potential to achieve significant general deterrence of drug-driving in a similar way as that achieved by best-practice RBT. While RDT is highly cost-effective at the modest levels of intensity that it is currently operated at in Australia, the analogy with RBT developed in this paper suggests that it will remain cost-effective if testing rates per licensed driver are increased up to 10% of drivers per year. However, to remain cost-effective at even higher testing rates per year, the cost per random drug test must be substantially decreased.

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Fast Electrochemical Test for Screening Drug Drivers

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Abstract

An electrochemical hand-held practical device for screening drug drivers in oral fluid (saliva) by the roadside is presented. The Oxtox^{TM} Drugsensor device utilises an ergonomic hand-held reader designed specifically for use by law-enforcement officers, a cartridge containing an electrochemical sensor and an oral fluid (saliva) collection device. Following saliva collection, results can be obtained within 30 seconds or less and currently can screen for delta-9-THC and methamphetamine at the low ng/mL level. Clinical trial data is presented analysing saliva from cannabis smokers and control non-smokers which are measured using the Oxtox^{TM} Drugsensor and independent confirmatory analysis (Gas Chromatography – Mass Spectrometry). The levels of delta-9-THC within oral fluid are found to rise to a maxima after 30 minutes which rapidly decreases over 120 minutes. The response of Oxtox^{TM} Drugsensor is found to correlate well with saliva delta-9-THC concentrations post cannabis smoking suggesting the device to be useful for screening delta-9-THC within oral fluid (saliva) samples.

Background

The requirement for reliable and practical devices for screening drug drivers is well understood. Oral fluid is the accepted medium for this. Drug screening products have been with us for many years but broad-scale roll-out of roadside drug-testing is being held up by lack of a device that adequately addresses user requirements.

Aims

To develop a sensor for drugs that is easy to use, easy to transport, requires a saliva sample of less than 100µL, delivers a result in less than 30 seconds and meets the required levels of sensitivity and selectivity set by the Australian police forces for delta-9-THC and methamphetamine.

Methods

In order to achieve the aims it was necessary to utilise a sensing system other than immunoassay. Electrochemistry is a highly sensitive, portable and rapid sensing methodology and has been the basis of the global billion dollar glucose sensing market allowing diabetics to readily monitor their blood glucose at home with clinically useful results obtained within seconds. In this context, electrochemistry utilises inexpensive disposable screen-printed electrodes and the use of proprietary chemical mediators to indirectly detect the presence of the target drugs. Once developed field trials were conducted with the detected drug content in the samples verified by independent laboratories.

Results

Clinical Trial:

Oral fluid (saliva) samples were collected from cannabis smokers (N = 2) and control non-smokers (N = 6). A single sample was taken from the controls but multiple samples (N = 10), both pre-smoking and at various intervals post-smoking, were taken from cannabis smokers.

Approximately 1.5 mL of Oral fluid (saliva) was collected for each panel of tests. Samples were collected from each donor by spitting into a glass screw top container.

Testing samples:

Samples were tested as soon as possible after collection.

For each donor sample:

(A) A Quantisal sample collection device was used. The tubes were stored in a fridge prior to being sent by courier to LabCorp, US for determination of THC content by GC-MS.

(B) The pH of each sample was determined using pH paper (Sigma, 0.0 - 14.0 and 7.0 – 14.0). The pH of each oral fluid sample was pH 7.0.

(C) Each sensor was tested by pipetting 300 uL of saliva onto the swab of the sampler, allowing approximately 20 seconds for the swab to absorb the sample, then applying the sampler to the sensor cartridge and starting the test.

Results

For the cannabis smokers, the reference assay gave a range of THC concentrations from 42 to 443 ng/mL, THC could not be detected on any of the non-smokers. As the lowest measurable concentration that could be measured by the reference assay in this trial was 42 – 44 ng/mL this was used as a pseudo cut-off. Using this cut-off 100% sensitivity and 100% specificity was obtained with sensors. The ratio of the average sensor currents produced by zero THC samples and the 42 - 44 ng/mL samples was 2.48.

Samples of Oral fluid (saliva) were taken both pre and post cannabis smoking over a 2 hour period. The results as depicted in figures 1 and 2 show, in two donors, the rise and fall of salivary THC concentration.

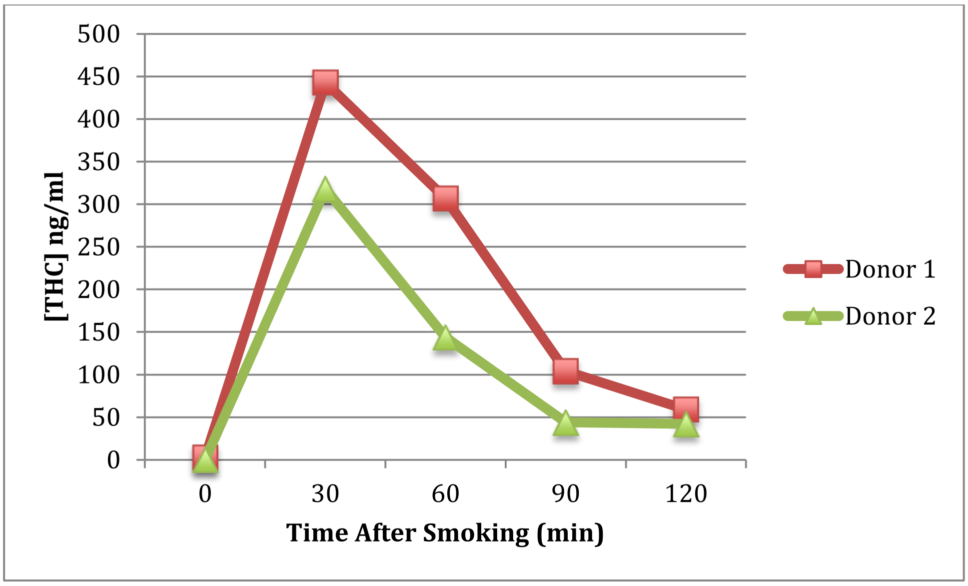

Figure 1. Oral fluid (saliva) THC concentrations post cannabis smoking

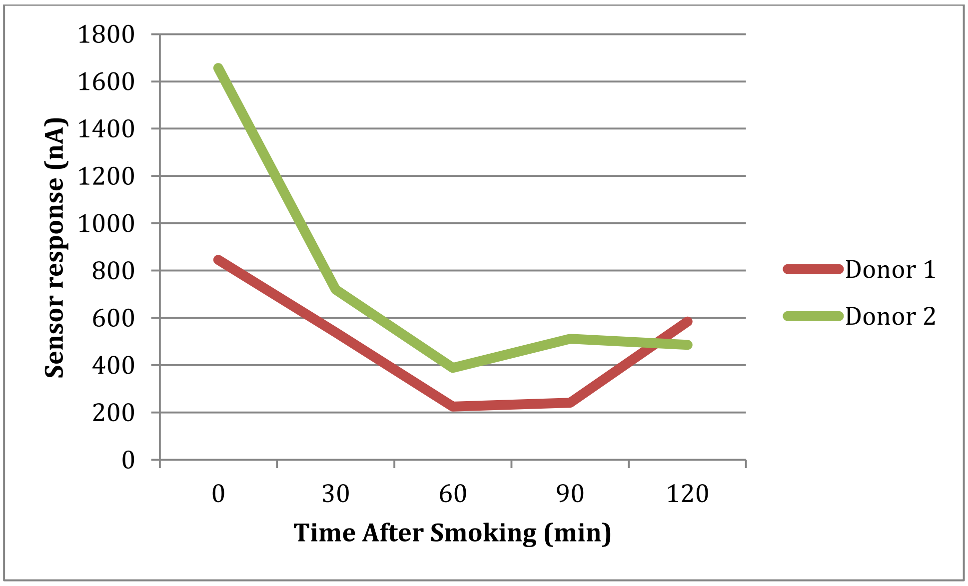

Figure 2. Electrode Response to varying oral fluid (saliva) THC concentrations post cannabis smoking

Conclusions

Conclusions from the project so far are that the electrochemical sensing of nominated drugs of abuse is a viable alternative to immunoassay and offers significant practical advantages. Through the analysis of cannabis smokers oral fluid (saliva) using the Oxtox^{TM} Drugsensor and independently validation (GC-MS), the correlation of levels of delta-9-THC within oral fluid was shown to be viable. Research and product development continues to optimise the system in pre-production prior to manufacturing scale-up. Oxtox technology roadmap includes sensors for other drugs, initially cocaine, opiates and amphetamine.

European Night Without Accidents – A peer-to-peer action against driving under influence with effective elements

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Abstract

Background
Since 3 years FACTUM participates, as the partner in Vienna, in a Europe-wide action which aims at promoting road safety, at increasing public awareness and at showing to youngsters that drinking and driving do not mix: the European Night Without Accidents (ENWA). Created 1995 in Belgium by `Responsible young drivers` (RYD) it covers the whole European Union. It is financially supported by the European Community. This year the action will be carried out in each Austrian federal state and will be cofinanced by the Austrian Ministry of Transport, Innovation and Technology (BMVIT).

Aims
Main aim of the campaign was the promotion of road safety focusing on young drivers, increasing public awareness and showing to youngsters that drinking and driving do not mix. The goal is to meet the youngsters in their own world. The presentation will provide an overview over the campaign elements, and will establish a link with the state of the art of campaigning according to the criteria of the EC project CAST how to carry out campaigns.

Methods
Young volunteers, positioned outside discotheques should encourage groups of youngsters to choose a "designated driver", who would stay sober and drive the other ones home safely. These "designated drivers" receive a bracelet, to be recognised when leaving the discotheque. Using a breathalyzer it could be made sure that they really are sober. This peer-to-peer action allows communicating more directly and successfully.

Results
In the year 2012, at the three discotheques involved in Vienna, three volunteers at each nightclub have been present, and 200 youngsters were approached**.** 75% of all who agreed to be a "designated driver" and stay sober, could stick to this (this percentage is in accordance with the average outcome of all participating member states). The others could be convinced by the volunteers not to drive.

Discussion and conclusions
The campaign was meaningful and the approach, namely with use of the peer-to-peer communication has been effective in achieving the goals. The procedures applied in the frame of the ENWA are in line with the recent state of the art regarding campaigning.

Introduction

The European Night Without Accident (ENWA) was created after observing the huge number of deathly accidents where young people were involved especially during weekends. The project “Responsible Young Drivers” (RYD) wanted to react.

For the first time in 1995, RYD organised a specific action to increase public awareness and to show youngsters that drinking and driving do not match. The ENWA was born. In the meantime it is co-funded by the European Commission D.G. Mobility & Transport.

The goal

The goal is to meet young people in their own world, on their grounds and communicate with them directly; these are the elements, which meet the targets of a good road safety communication campaigning (according to the Manual for Designing, Implementing and Evaluating Road Safety Communication Campaigns, Delhomme et al 2009).

The concept of ENWA is that young volunteers, all between 17 and 29 are positioned outside discotheques or nightclubs. There they should encourage groups of youngsters to choose a designated driver, who would stay sober and drive the other ones home safely. Persons who volunteer to act as designated drivers receive a bracelet so that they can be recognised when leaving the discotheque. It should be made sure and proven that they really are sober when leaving the discotheque.

From 1995 on, once a year on the third Saturday of October, RYD have been present in many nightclubs in Belgium (~40). Step by step other EU countries joined and in the meantime ENWA covers the whole European Union. In Austria, from 2010 to 2012 the campaign took place at three well known discothèques in Vienna, organised by the research institute FACTUM OG.

How the action took place

The action took place in two phases. First, the volunteers, all between 17 and 29, were settled in each nightclub. The team of volunteers welcomed the drivers at the entrance and encouraged them to take up a responsible attitude behind the wheel. They encouraged each group to choose a “designated driver” who would commit him/herself to stay sober in order to be able to drive a car, later on. If they participate, the volunteers ask them to wear a bracelet to be recognizable as a symbol of their commitment.

Second, when the “designated driver” leaves the nightclub, he/she has the opportunity to voluntarily undergo a breathalyzer test to check if the commitment was kept. Also, a sample of drivers was asked to try a drug test, of course on a voluntary basis. In this way they could prove to their friends and passengers that they are “clean”. If this was the case, the “designated driver” was rewarded with some gifts offered by our partners and sponsors. If not, the person was encouraged to leave his/her car on the side or to entrust the car to a friend who had not drunk any alcohol nor taken any drugs.

In all cases it should be avoided to send a negative message. On the contrary, all volunteers working in the campaign always tried to discuss with the group so they would find the most reasonable solution to return home safely.

When the “designated drivers” left the nightclub, they could voluntarily have a breath analysis made (volunteers had breathalysers with them), in order to check if they still were legally allowed driving. If the analysis showed that this was the case the “designated drivers” were rewarded with some gifts offered by sponsors. If not, the volunteers would encourage them to let their car parked on the side or to hand over the keys to a friend who had not drunk any alcoholic beverage.

Outcome

In 2012, during the European Night Without Accident, more than 776 volunteers were present in about 142 nightclubs located in 23 EU Member States. In Austria, at the three discotheques involved in Vienna, where three volunteers at each nightclub have been present, 200 youngsters could be approached before entering the clubs. 124 bracelets were distributed during the evening. 81 who had taken the bracelets came back before 4.00 in the morning to do the breathalyzer tests (i.e. before our assistants left). Out of these 81 respondents, 70 (75%) were sober. This is in accordance to most other countries where the mean percentage of sober youngsters lay at 82% (see: http://www.europeannightwithoutaccident.eu/enwa-2012.php).

Interestingly, there were many more who wanted to use the breathalyzer and find out their status concerning alcohol. However, they did not officially take part in the action because most of them came without a car. Anyway this interest in the action was an important sign that the campaign was meaningful and the approach, namely with use of the peer-to-peer communication has been useful in achieving goals.

Figure 1: Action ENWA and campaign material in front of discotheque.

Most of those who had drunk alcohol were below 0, 5 %o. Only one had more than 1,0%o. However, as in Austria young drivers who still have a preliminary driving licence (which is the case for two years after passing the exam) are only allowed a BAC < 0,1 any BAC > 0 was noted as “not sober”.

If youngsters were sober at the end of the night they were given small gifts (cakes, safety jackets, etc.), information leaflets and a one-way promille tester. If they were not sober there was a discussion between volunteers and youngsters how they could make their way back home. As both discotheques are situated close to subways, and taxis were standing close to the entrances it was easy to show them a safe way to get back home.

Cooperation with night club owners, authorities and press

The nightclub owners have been estimated as very cooperative and interested in the traffic safety of their clients. They accepted the campaign to be carried out in front of their nightclub already across three years.

In 2012 authorities of some districts in the vicinity of the nightclubs have shown interest in the action and supported it with some amount of money so that more posters and leaflets could be printed out.

The press was informed extensively before and after the event, which should contribute to raise public awareness. Basic materials like guidelines for press releases had been provided by RYD in advance, in order to make the project more homogeneous.

Discussion and conclusions regarding efficient campaigning

Based on previous definitions, road safety campaigns are defined by the CAST (http://www.cast-eu.org/) consortium (EU-project CAST Campaigns and Awareness-Raising Strategies in Traffic Safety, Delhomme et al 2009) as:

> “Purposeful attempts to inform, persuade, or motivate people in view of changing their beliefs and/or behaviour in order to improve road safety as a whole or in a specific, well-defined large audience, typically within a given time period by means of organised communication activities involving specific media channels often combined with interpersonal support and/or other supportive actions such as enforcement, education, legislation, enhancing personal commitment, rewards, etc”.

Campaigns are assumed to be more likely to succeed if they tackle only one, well-defined theme and select a specific target audience. Moreover, any campaign should be based on extensive research and relevant theoretical models, which help not only in identifying the main predictors of the problem behaviour but also in designing the campaign message. It is also necessary to understand whether or not the behaviour is intentional.

Next, it is important to understand the motives behind the unsafe behaviour as a starting point for the social marketing framework that was applied to influencing the target groups’ behaviour. A major requirement is that researchers, decision-makers and practitioners work closely together to make the campaign a success.

According to CAST, the effects of any campaign should be shared with a large audience, by means of a final report, publications, presentations etc.. Systematic reporting on past campaigns and collecting feedback can provide valuable input for future initiatives. Furthermore, evaluation activities, e.g. in the frame of meta-analyses, should be carried out in order to assess the success of any campaign and to identify key elements likely to lay the foundation for such a success.

In the frame of ENWA all these topics have been taken into consideration. Based on research about traffic accident statistics as well as methods concerning peer-to-peer education, the message of the RYD is simple and clear - “Young people convince other young people about the importance of responsible behaviour behind the wheel”; “responsibility” in this case is connected to alcohol consumption. The message is credible, with young people as the campaign personnel who forward it to other young drivers. Peers use to understand motives and attitudes of group members of their own age easier and are more accepted by them. The method used is insisting on the need to modify young driver’s attitude as well as behaviour “on the spot”. This seems to be one promising way to obtain permanent results. To compare the results of the evenings within the member states who participate and across the years evaluation material is provided by RYD. Further on publications about the campaign and the results are a must within the ENWA since the beginning of the project. Participating institutions (NGOs, research institutes and practitioners) work together with decision-makers and stakeholders. All these parts can be taken as signs of an efficient campaign according to the suggestions of CAST.

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Alcohol and drugs among motorcycle riders compared with car and van drivers killed in road crashes in Norway during 2001-2010

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Abstract

Background
Approximately 3.05 million motor vehicles are registered in Norway. Motorcycles and mopeds (MMs) represent 11% of the vehicles and 2% of the rides but as much as 21% of drivers killed in road traffic crashes.

Aims
To investigate the prevalence of alcohol and drugs above the legislative limits among MM riders killed in road traffic crashes and compare with killed car and van (CV) drivers.

Methods
Blood samples were selected from those routinely submitted by the police for analysis of alcohol and drugs in fatal traffic accidents during 2001-10. They were coupled with data from the Norwegian Road Traffic Accident Registry. Samples were analysed for alcohol and drugs.

Results
We received blood samples from 63% of the killed drivers for analysis of alcohol and drugs. The age distributions were different for MM and CV drivers; <25 years: 34% and 27%, 25-34 years: 27% and 22%, 35-54 years: 35% and 26%, above 54 years: 4% and 25%, respectively. Alcohol or drugs were found in samples from 40% and 27% of killed CV and MM drivers; for single vehicle (SV) accidents 64% and 45%. Alcohol was most commonly found among drivers below 25 years, illicit drugs among those 25-34 years and medicinal drugs among those 35-54 years. Amphetamines and benzodiazepines were the most frequently found illicit and medicinal drug groups. The highest prevalence of alcohol or drugs was found in samples from drivers killed in SV accidents during weekend nights.

Discussion and conclusions
MM drivers were more often involved in fatal accidents compared to the fraction of MM vehicles in normal traffic. However, the prevalence of alcohol or drugs was lower among MM drivers compared to CV drivers. One reason for the difference may be that MM drivers are less protected in an accident compared to CV drivers.

Introduction

Of the 3.05 million motor vehicles registered in Norway, MMs represent 11% of the vehicles and 2% of the rides. During the time period from 2001-10, 1517 drivers were killed in Norway; 71% were drivers of CVs and 22% of MMs. Of the killed MM riders, 44% died in SV accidents. However, the fact that MM riders were involved in one out of five fatal accidents shows that the risk for involvement in a fatal crash is significantly higher among MM riders than among CV drivers.

Several countries have reported high incidence of accidents among MM riders (NHTSA, 2007; Lin & Kraus, 2009; Moskal et al., 2012). Epidemiological studies have shown about 20 to 30-fold higher risk of fatal crash among MM riders and at least 8 times higher risk for injury in road crash compared with other vehicle accidents (NHTSA, 2007). The number of accidents among MM riders in Norway has decreased during the last years, but still the risk for traffic injury is at least six times higher than for CV drivers (Bjørnskau et al., 2012).

Several risk factors may contribute to the high accident rates: the drivers are often young men with little traffic experience, the speed is often high, many drivers are risk and sensation seeking, and many drivers are not using helmet or protective suit (Villaveces et al., 2003; Lin & Kraus, 2008, Stella et al., 2002).

MM drivers have received less attention than CV drivers regarding studies of alcohol or drugs. Several studies of alcohol use among injured or killed MM drivers have been published; few studies on the use of drugs, and the number of cases included have been low (Pechansky et al., 2010; Stella et al., 2002; Kasantikul et al., 2005; Bogstrand et al., 2011).

Norway implemented legislative limits for 20 non-alcohol drugs in 2012 including both illicit drugs and medicines with warning labels (Vindenes et al., 2012). The drug concentration limits correspond to impairment comparable to the legal blood alcohol concentration (BAC) limit of 0.02 g/dl in the Norwegian Road Traffic Act.

The aim of this study was to investigate the prevalence of alcohol and drug concentrations above the Norwegian legislative limits among MM riders who died in traffic accidents during the period from 2001-2010, with specific focus on SV crashes, and compare with killed CV drives during the same time period.

Materials and methods

Selection of cases

Blood samples were selected from those routinely submitted by the police for analysis of alcohol and drugs in cases of fatal traffic accidents. The samples were collected either shortly after the accident when the drivers were still alive, immediately after death or at legal autopsy. The study included MM riders and CV drivers who died within 24 hours after the accident. Samples were analysed at the Norwegian Institute of Public Health (NIPH) for alcohol, illicit drugs and medicines. The results were recorded in the forensic toxicological database at NIPH and further coupled with the Norwegian Road Traffic Accident Registry operated by Statistics Norway, which is based on information submitted by the police. Data were coupled by using the national identification number of the drivers. The final research database contained data on age, gender, time of accident, accident site, SV accident (yes/no), time of death, time of blood sampling and analytical results. Diazepam and morphine detected as results of reported or likely emergency treatment after the accident were omitted from further evaluation. Permission for the study, including coupling of data with the Road Traffic Accident Registry, was given by the Regional Ethical Committee and the Director of Public Prosecutions.

Analysis of alcohol and drugs

The following compounds were included in the analytical programme (cut-off limits in parentheses): alcohol (0.02 g/dl). Stimulants: amphetamine (41 ng/ml), methamphetamine (45 ng/ml), MDMA (48 ng/ml), cocaine (24 ng/ml). Opioids: morphine (9 ng/ml), methadone (25 ng/ml). Cannabis: THC (1.3 ng/ml). Anxiolytics, hypnotics: alprazolam (3 ng/ml), clonazepam (1.3 ng/ml), diazepam (57 ng/ml), flunitrazepam (1.6 ng/ml), nitrazepam (17 ng/ml), oxazepam (172 ng/ml), zolpidem (31 ng/ml), zopiclone (12 ng/ml). Sample handling and analytical methods have been described earlier (Gjerde et al. 2013). The results from positive screening analyses were not reported if not sufficient blood volume was available for confirmation analyses.

Results

Blood samples were received from 63% (n=207) of the MM drivers killed on Norwegian roads, representing 198 male and 9 female drivers and 63% (n=676) of the CV drivers, representing 560 male and 116 female. Autopsy samples from two Norwegian regions were analysed at the University in Trondheim, representing about 5% of the killed drivers; results from those cases are not included in this study. The reasons why the other fatal accidents were not investigated for alcohol or drugs, might be long transport distance to legal autopsy, economical reasons or that alcohol or drugs was not suspected.

Alcohol and drug findings

Table 1 shows the prevalence of alcohol and drugs among all investigated MM and CV killed drivers. Alcohol or drugs were more often detected in samples from CV drivers than MM drivers and most often in samples from SV accidents because the SV drivers were in most cases culpable as no other vehicle has been involved. Amphetamines and benzodiazepines were the most commonly found illicit and medicinal drug groups.

Age distribution and gender

Most of the killed MM drivers were male, only 4.3% of the investigated MM drivers were female; one of them had a BAC above the legal limit, none had any drug concentration above the limit. Among CV drivers, 17.2% was female; alcohol was found in blood samples from 7.8% of those drivers, medicinal drugs in 14.7% and illicit drugs in 6.0%.

The age distributions were different for MM and CV drivers; <25 years: 34% and 27%, 25-34 years: 27% and 22%, 35-54 years: 35% and 26%, above 54 years: 4% and 25%, respectively. Among MM drivers, alcohol was most often found among killed MM drivers below 25 years, illicit drugs among drivers aged 25 to 34 years, and medicinal drugs among drivers above 55 years (Table 2). Similar pattern was found for CV different drivers, except that the prevalence of alcohol and drugs was higher than among killed MM riders.

Time periods for accidents

The highest prevalence of alcohol or drug related accidents were recorded for drivers killed in SV accidents during weeknights and weekend nights: 60.9% and 65.2%, respectively. The corresponding figures for CV drivers killed in SV accidents were higher: 83.9% and 89.3%, respectively.

Table 1. Prevalence (%) of alcohol, medicines, illicit drugs and combinations, among MM riders (n=207) and CV drivers (n=676) killed in road traffic accidents during the period 2001-2010.

Substance	MM drivers		CV drivers	
	All accidents	SV accidents	All accidents	SV accidents
Alcohol	17.4	32.5	25.3	49.1
Alcohol + drug(s)	3.9	8.4	7.0	12.9
Medicinal drugs	7.7	14.5	14.5	17.7
Benzodiazepines	6.3	13.3	11.7	14.8
Illicit drugs	9.2	13.3	14.1	19.2
Amphetamines	6.3	10.8	9.6	12.2
One or more drugs	13.5	20.5	21.9	27.7
Alcohol or drugs	27.1	44.6	40.2	63.8

Table 2. Prevalence of alcohol, medicines, illicit drugs and combinations in different age groups of killed MM and CV drivers.

Substance	MM drivers				CV drivers			
	<25	25-34	35-54	55+	<25	25-34	35-54	55+
Alcohol	20.0	17.9	15.1	12.5	38.0	30.9	25.4	6.5
Alcohol + drug(s)	4.3	5.4	2.7	0.0	10.9	13.4	3.5	0.6
Medicinal drugs	7.1	8.9	6.8	12.5	11.4	20.8	19.1	7.6
Benzodiazepines	4.3	8.9	6.8	0.0	9.8	19.5	14.5	4.1
Illicit drugs	4.3	17.9	8.2	0.0	17.9	28.2	11.0	0.6
Amphetamines	4.3	10.7	5.5	0.0	9.8	21.5	8.1	0.6
One or more drugs	10.0	19.6	12.3	12.5	23.9	33.6	23.1	8.2
Alcohol or drugs	25.7	32.1	24.7	25.0	51.1	51.0	45.1	14.1

Discussion

The prevalence of alcohol and drugs among MM drivers killed in road accidents in Norway was lower than among killed CV drivers (Table 1). Thus, other risk factors in addition to alcohol or drugs may play an important role. A Norwegian study of accident risk among MM riders based on questionnaires and analyses of accidents concluded that the most important risk factors were low age, low experience, risky behaviour and unsafe attitudes (Bjørnskau et al., 2012). Questions or investigation of alcohol or drugs use were not included in that study. Another Norwegian study on the prevalence of alcohol and other drugs among injured patients in an emergency department, including MM riders and other vehicle drivers, showed similar total prevalence for any substance found in blood samples from the two groups of drivers (approximately 25%). However, the number of MM riders was low. Other studies have shown higher prevalence of alcohol among accident involved MM riders compared to our results, varying from 30% to 49% (Kasantikul et al., 2005; Villaveces et al., 2003; CDC, 2004). Drug related accidents have not been included in those studies. In a roadside study in Brazil, saliva samples were analysed and showed higher prevalence of certain drugs among MM riders compared to CV drivers, but lower prevalence of other drugs (Pechansky et al., 2010). When comparing findings of alcohol and different drug groups among MM and CV accident riders in our study, no significant differences in drug use patterns were found for killed MM compared with CV drivers, except that the prevalence was lower among MM riders (Table 1). The comparison of different age groups of MM and CV drivers also show very similar pattern of alcohol, medicines, illicit drugs and their combinations in the individual age groups with lower prevalence for all MM age groups, except for medicinal drugs among those above 55 years; however, the number of the latter cases was very small.

Conclusion

Alcohol and other drugs was frequently found in blood samples from MM and CV drivers killed in road crashes, although lower among MM riders. Even with helmet and other sufficient protective devices, the MM riders are less protected when involved in an accident compared to CV drivers. Drivers and riders killed at night-time had more often used alcohol or drugs. This fact should be taken into consideration by the police when planning time for controls.

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Specific biomarkers of internalizing and externalizing characteristics among first-time driving while impaired offenders

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Abstract

Background
Studies have described the externalizing (e.g., antisocial propensity) and internalizing (e.g., anxiety, depression) characteristics of driving while impaired (DWI) recidivism. However, the respective contribution of those characteristics to recidivism risk and their underlying mechanisms are still unknown. Cortisol, a stress hormone, is a biomarker underlying various high-risk characteristics. Studies have found that first-time DWI (fDWI) offenders and recidivists have lower cortisol reactivity (CR) than non-DWI drivers. In other high-risk populations, internalizing characteristics has been positively correlated to cortisol basal levels (CBL). To disentangle the distinct recidivism trajectories in the fDWI offender population, this study explored whether cortisol measures were markers of externalizing and internalizing characteristics.

Aims
Hypotheses 1: CR is lower among fDWI offenders with higher versus lower externalizing propensity (driving violations, criminal arrests, antisocial tendency, sensation seeking, impulsivity); 2: CBL is higher among fDWI offenders with higher versus lower internalizing propensity (anxiety, depression).

Methods
Male fDWI offenders (n = 126) were recruited and submitted to the following protocols: *Millon Clinical Multiaxial Inventory* (antisocial tendency, anxiety, depression); *Addiction Severity Index* (major driving violations, criminal arrests); *Sensation Seeking Scale*; *Barratt Impulsivity Scale* and salivary cortisol measured after a psychosocial stress task and during a resting day. Cluster analyses and ANOVA were performed.

Results
fDWI offenders with higher externalizing propensity have a lower CR compared to offenders with lower propensity ($F(1, 124) = 5.85$, $p = .017$). Moreover, CBL is higher among offenders with higher versus lower internalizing propensity ($F(1, 124) = 5.55$, $p = .020$).

Discussion and conclusions
The current study revealed dissimilar associations between cortisol measures and externalizing and internalizing propensity among fDWI offenders. These results suggested that externalizing and internalizing characteristics, two high-risk dimensions associated to DWI recidivism, involved in specific underlying mechanisms. Increasing knowledge on these underlying mechanisms may more precisely explain the various etiological pathways to DWI recidivism.

Introduction

Road traffic injuries represent the ninth leading contributor to the burden of disease and injury (World Health Organization, 2004). Approximately one third of first-time driving while impaired (fDWI) offenders will recidivate (Impinen et al., 2009), with recidivists responsible for a disproportionate number of accidents involving alcohol (Nochajski & Stasiewicz, 2006). In order to improve traffic safety, a better understanding of the propensity of engaging in high-risk behaviour by fDWI offenders is needed.

High-risk propensity: externalizing and internalizing characteristics

Various studies have identified high-risk characteristics associated to driving while impaired (DWI) recidivism risk. Externalizing characteristics, as defined by criminal and antisocial behaviours, have been frequently linked to recidivism (LaBrie, Kidman, Albanese, Peller, & Shaffer, 2007). Attention has more recently turned to internalizing characteristics (i.e., depression, anxiety) in DWI. For example, a study investigating various personality and mental health characteristics among severe DWI offenders (BAC $\geq$ 0.10%) has shown that the only significant predictor of DWI relapse, over a two-year period, was depression (Hubicka, Källmén, Hiltunen, & Bergman, 2010). Furthermore, a high anxiety subgroup had instigated more at-fault crashes over the past three years and had more DWI episodes during the preceding year compared to low and medium anxiety subgroups (Dula, Adams, Miesner, & Leonard, 2010). Externalizing and internalizing characteristics seems associated with different pathways to fDWI behaviour (Schlauch, O'Malley, Rounsaville, & Ball, 2012). Still, the association between externalizing and internalizing characteristics and high-risk driving behaviours has not always been consistent (Ulleberg & Rundmo, 2003), suggesting that behavioural indices may be inadequate for disentangling the different trajectories to DWI. To reconcile these inconsistencies, one strategy is to shift focus onto neurobiological markers of behavioural risk.

Underlying neurobiological mechanisms of externalizing and internalizing characteristics

Investigators have suggested to incorporate biological and genetic factors for an improved understanding of DWI recidivism propensity (Eensoo, Paaver, Harro, & Harro, 2005). After exposure to a psychological or physiological stress, a cascade of hormones is activated from hypothalamic-pituitary-adrenal (HPA) axis with cortisol released from the adrenal cortex in the last stage of this process. Cortisol excretion follows a circadian rhythm that fluctuates throughout the day. As such, cortisol may be measured as cortisol basal level (CBL) or as reactivity (CR) to a stressful situation. The relationship between HPA axis, alcohol abuse and delinquent behaviour, led Brown and colleagues (2005) to posit that dysregulation of the HPA axis might be at play in DWI offenders as well.

Some studies showed that CBL or CR may be related differently to externalizing and internalizing characteristics. For now, some externalizing characteristics have been investigated in relation to CR of DWI offenders. First, Brown and colleagues (2005) found that CR of DWI offenders, measured by sampling saliva during a challenging neuropsychological assessment, was inversely correlated to the frequency of previous DWI convictions, a relationship especially marked in recidivists and significantly independent from alcohol abuse severity. Second, recidivists (Couture et al., 2008) and fDWI offenders (Couture et al., submitted) had a reduced CR than non-DWI controls. Finally, compared to fDWI offenders with higher CR to stress, offenders with lower CR were more likely to show lower educational achievement, exhibit greater impulsiveness, and smoke cigarettes. In these studies, stress reactivity was considered as the difference between pre-stress and post-stress cortisol measures. As such, lower CR seems related to various externalizing characteristics among DWI offenders, although CBL did not seem significant. In other populations, internalizing characteristics have been usually linked to CBL. Among adolescents, internalizing characteristics were associated to morning levels of cortisol (Ruttle et al., 2011). In addition, healthy young men with higher trait anxiety were associated to higher CBL but not to CR (Takahashi et al., 2005). Moreover, patients with major depressive disorders had higher CBL in the afternoon than controls, but no effect was found for CR (Burke, Davis, Otte, & Mohr, 2005). Even among healthy young adults, depressive symptomology was linked to higher CBL during waking hours (Pruessner, Hellhammer, Pruessner, & Lupien, 2003). To date, no studies conducted with DWI offenders have considered the association between internalizing characteristics and CBL.

In order to improve our understanding of DWI recidivism risk, the present study aimed to increase knowledge on how dissimilar HPA axis dimensions might be linked to higher externalizing and internalizing propensity. The study tested two hypotheses: 1) CR is lower among fDWI offenders with higher than those with lower externalizing propensity (driving violations, criminal arrests, antisocial tendency, sensation seeking, impulsivity); 2): CBL is higher among fDWI offenders with higher than those with lower internalizing propensity (anxiety, depression).

Methods

The current study, part of a longitudinal study, was conducted at the Douglas Mental Health University Institute, a McGill University affiliated facility located in Montreal, Quebec, Canada. Male fDWI offenders (*n* = 126) were recruited from ethics approved newspaper advertisements, posters and invitation letters displayed in public addiction treatment centers and company certified to install mandated interlock devices. Inclusion criteria: 1) age between 18 and 44 years; 2) minimum of a 6th grade education; 3) access to official driving records from 2002 to 2016; and 4) fDWI conviction within the past 24 months. Exclusion criteria: 1) female sex, 2) medical conditions that could interfere with normal HPA, and 3) risk of alcohol withdrawal (assessment scale and physician examination) or alcohol consumption (blood alcohol concentration > 0.01% or visible substance-induced impairment) on testing day. Participants were invited to three sessions on separate days. The first session involved psychosocial and neuropsychological questionnaires. The next two sessions measured cortisol level with nine saliva samples. One session comprised of a resting period and the other, a stress task. The stress task comprised of answering mathematical questions under a time constraint for a monetary prize.

Measures
For this study, the antisocial predisposition, anxiety and depression were assessed with the *Millon Clinical Multiaxial Inventory III* (Piotrowski, 1997). Sensation seeking was measured with the *Sensation Seeking Scale form V* (Zuckerman, 1994), and impulsivity was measured using the *Barratt Impulsivity Scale version 11*. Moreover, non-DWI major driving violations and non-DWI criminal arrests since the age of 18 (dichotomised as absence = 0 or presence = 1) were measured with the legal section of the *Addiction Severity Index* questionnaire (McLellan et al., 1985). Sociodemographic information was gathered from a combination of the *Composite International Diagnostic Interview* version 2.1 (World Health Organization, 1997), and specific questions regarding age, years of education, income, and kilometres driven during past 12 months. Cortisol level (µg/100 ml) was assessed with cotton swabs Salivette® devices. Using the nine samples from the rest session, CBL was calculated with the "area under the curve with respect to ground" formula (Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). CR was considered as the difference between the sample before and after the stress task and during the stress session.

Analyses
Twostep clusters were performed, with forced two classes, to classify fDWI offenders with higher and lower externalizing (driving violations, criminal arrests, antisocial tendency, sensation seeking, impulsivity) and internalizing (anxiety, depression) propensity, respectively. CR and CBL, as independent variables, were then entered in a one-way ANOVA for both cluster groupings (higher or lower externalizing and internalizing propensity).

Results

Participants had a mean age of 27.9 years (*SD* = 6.8), 14.1 years of education (*SD* = 2.6) and drove 10 937.7 kilometres during the past year (*SD* = 13 575.4). As expected in the first hypothesis, fDWI offenders with higher externalizing propensity had lower CR (*M* = .04, *SD* = .17) compared to offenders with lower externalizing propensity (*M* =.19, *SD* =.37; $F(1, 124) = 5.85$, $p = .017$, partial $\eta^2 = .05$). Finally, second hypothesis was also supported, more precisely, fDWI offenders with higher internalizing propensity had higher CBL (*M* = 73.87, *SD* = 86.11) than offenders with lower internalizing propensity (*M* = 46.86, *SD* = 42.20; $F(1, 124) = 5.55$, $p = .020$, partial $\eta^2 = .04$). Additional analysis suggested that fDWI offenders with higher or lower externalizing propensity were not differently distributed on higher or lower internalizing propensity ($\chi^2(1) = 0.54$, $p = .548$).

Discussion and conclusions

To date, studies of DWI offenders' characteristics have rarely considered externalizing and internalizing characteristics simultaneously (Schlauch, et al., 2012) and their respective neurobiological underpinning. Though, such an approach may improve the inherent limits of descriptive research by understanding the fundamental mechanisms involved in DWI recidivism risk. In the current study, the consideration of two neurobiological markers (i.e., CR and CBL) seemed useful to identify two distinct ways offenders might get to DWI recidivism.

The two hypotheses of the present study were supported. The CR was lower among fDWI offenders with higher versus lower externalizing propensity, and the CBL was higher among those with higher versus lower internalizing propensity. As such, even among the same fDWI offender sample, both externalizing and internalizing characteristics were present and linked differently to HPA axis dimensions. As seen among other populations, externalizing and internalizing characteristics were associated to different HPA axis dimensions. For example, among adolescents, externalizing characteristics were associated to diurnal cortisol slope (i.e., the amount of cortisol decline during the day) and internalizing characteristics were associated to morning levels of cortisol (Ruttle, et al., 2011). Still, the non-distinctiveness between externalizing and internalizing propensity grouping underlined the high comorbidity between these two distinct high-risk dimensions. To improve our understanding of DWI recidivism risk, the investigation of these two distinct, but highly linked, characteristics is warranted.

This cross-sectional study had some inherent limitations. First, it is impossible to attest whether CR or CBL predated or resulted of externalizing and internalizing characteristics. In addition, it is too early to speculate the reason why these characteristics were linked to different HPA axis dimensions. Still, it will be interesting to investigate, with the longitudinal part of the study, if these two different pathways are linked to future high-risk driving behaviours. Secondly, the study may not generalize to female fDWI offenders. In fact, female fDWI offenders have less externalizing and more internalizing characteristics compared to male fDWI offenders (Lapham et al., 2001).

To conclude, determination of subgroups with genetic/biological, physiological and behavioural endophenotypes may help better understand the various risk factors related to the development of high-risk behaviours (Hines, Ray, Hutchison, & Tabakoff, 2005). Accordingly, the current study added to this research area by improving knowledge on the various pathways to DWI recidivism risk.

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Determinants of drink-driving and association between drink-driving and road traffic fatalities in Ghana

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ABSTRACT

Background

Drink-driving has been implicated in many road traffic crashes in the world. Consequently, the developed countries have prioritized drink-driving research. Contrary, drink-driving research has not attained any meaningful consideration in many developing countries. It is therefore imperative to intensify drink-driving research so as to provide research driven solutions to the menace.

Aims

The objective is to establish determinants of drink-driving and its association with traffic crashes in Ghana.

Methods

A randomized roadside breathalyzer survey was conducted. A multivariable logistic regression was used to establish significant determinants of drink-driving and a bivariate logistic regression to establish the association between drink–driving and road traffic crashes in Ghana.

Results

In total, 2,736 motorists were randomly stopped for breath testing of whom 8.7% tested positive for alcohol. Among the total participants, 5.5% exceeded the legal BAC limit of 0.08%. Formal education is associated with a reduced likelihood of drink-driving compared with drivers without formal education. The propensity to drink-drive is 1.8 times higher among illiterate drivers compared with drivers with basic education. Young adult drivers also recorded elevated likelihoods for driving under alcohol impairment compared with adult drivers. The odds of drink-driving among truck drivers is OR=1.81, (95% CI=1.16 to 2.82) and two wheeler riders is OR=1.41, (95% CI=0.47 to 4.28) compared with car drivers. Contrary to general perception, commercial car drivers have a significant reduced likelihood of 41%, OR=0.59, (95% CI=0.38 to 0.92) compared with the private car driver. Bivariate analysis conducted showed a significant association between the proportion of drivers exceeding the legal BAC limit and road traffic fatalities, $p<0.001$. The model predicts a 1% increase in the proportion of drivers exceeding the legal BAC to be associated with a 4% increase in road traffic fatalities, 95% CI= 3% to 5% and vice versa.

Discussion and conclusion

A positive and significant association between roadside alcohol prevalence and road traffic fatality has been established. Scaling up roadside breath test, determining standard drink and disseminating to the populace and formulating policies targeting the youth such as increasing minimum legal drinking age and reduced legal BAC limit for the youth and novice drivers might improve drink-driving related crashes in Ghana.

INTRODUCTION

Impaired driving, particularly, drink-driving has been identified as a major risk factor of road traffic crash frequencies and severity (Global Road Safety Partnership, 2007; Longo, Hunter, Lokan, White, & White, 2000; Wells & Macdonalds, 1999; WHO, 2009). Most countries which have prioritized alcohol research seem to have found a concurrent decline in drink-driving and its related road traffic injuries and fatalities. According to Chang et al., (2012), in the United States, alcohol related fatalities have significantly declined from 60% in 1982 to 40% in 2006 due to the effectiveness of countermeasures premised on deterrent laws. On the contrary, in developing countries, no discernible pattern of alcohol-related research protocols has been established. The paucity of alcohol-related research in developing countries has been reported by (Mock, Asiamah, & Amegashie, 2001; Obot, 2000). Evidence of drug and alcohol impairments are only sought when crashes involve public figures (Owusu Achiaw & Donkor, 2007). There is however evidence suggesting frequent use of alcohol and other drug among adolescents in Ghana (Adu-Mireku, 2003; Doku, Koivusilta, & Rimpela, 2012), thus, suggesting the potential involvement of alcohol in traffic crashes. The extent to which alcohol use is translating into road traffic crashes is yet to be studied in greater detail in Ghana and Africa. This situation does not augur well for road safety in developing countries. One way Ghana can improve their road safety situation is to prioritize alcohol research. The objective of the study is to establish the determinants of roadside drink-driving prevalence and its association with road traffic injury severity in Ghana.

METHODOLOGY

The cross-sectional study design was used for the alcohol data collection. There was no prospective or retrospective follow-up of participant drivers on their drinking history. No identifiable information regarding the drivers' name, telephone and car numbers was collected.

Sampling technique

Systematic random sampling was used in selecting candidate drivers in which every fifth vehicle was stopped for breath test and interview. In few cases, some fifth cars were allowed to pass when successive samples had been repetitively of one mode of vehicle in which case purposive sampling was used instead to cater for other modes which would have been otherwise underrepresented in the regular sampling frame.

RESULTS

In total, 2,736 drivers were randomly stopped and their BrAC measured with the breathalyzer; Alco-sensor V. Among those drivers whose BrAC were tested, 8.7% had detectable alcohol in their breaths whilst 5.5% exceeded the legal alcohol BAC limit of 0.08% in the country.

Determinants of drink-driving among Ghanaian drivers

A multivariable logistic regression analyses in which drivers BAC levels was stratified into binary levels; (a) BAC above legal limit and (b) otherwise to determine which covariates are associated with drink-driving was carried out and the results displayed in Table 1. In the logistic regression, the variable vehicle type was categorized into five levels namely; bus, bicycle/motor cycles, cars (including taxis) and trucks. Other covariates and their respective levels were (1) drivers' educational level i.e. none, basic education, secondary school certificate qualification, and tertiary or higher qualification (2) drivers' age stratified into 18-29 year olds, 30-39 year olds, 40-49 year olds, 50-59 year olds and 60 or more years; (3) driver category i.e. private or commercial vehicle category; and (4) day of the week.

Driving trucks was significantly associated with impaired driving, p=0.009. The odds of being found drunk on the roadway is two times higher among truck drivers compared with car drivers, OR=1.8; (95% CI: 1.16 to 2.82). There was no significant differences between the likelihood of being drunk among two-wheeler riders (cyclists and motorcyclists), p=0.535 and bus drivers p=0.406 when compared with car drivers. Having a formal education is seen to be a significant predictor of lower propensity for drink-driving. Drivers without any formal education were associated with an elevated likelihood of drink-driving, p=0.012. Compared with drivers who has basic education, the odds of being drunk among drivers without any formal education was OR=1.8: (95% CI: 1.14 to 2.98). There appears to be a consistent similarity regarding the association among drivers with formal education and drink-driving. The odds of being found drunk among secondary school graduate and tertiary level graduate drivers were not significantly different p=0.692 and p=0.447 respectively compared with drivers with basic education.

As illustrated in Table 1, age of drivers was a significant predictor of drink-driving in Ghana. By comparing the youngest drivers' age groups, i.e. the (18-29) and 30-39 year-olds with the 40-49 year-olds yielded significantly higher likelihood of drink-driving OR=1.6 and OR=2.0 respectively. The 50-59 year-olds were also at 3.2 chance of drink-driving compared with the 40-49 year olds, p<0.001. The likelihood for the aged to drink-drive was not however significantly different from the referent age group the (40-49 year-olds) p=0.817.

Table 1: Predictors of drink-driving in Ghana

	Logit	Odds	P - value	95% CI OR
Vehicle Type				
Bus	-0.192	0.825	0.406	0.52 to1.30
Two wheelers	0.350	1.419	0.535	0.47 to 4.28
Cars	-	1	-	-
Truck	0.593	1.810	0.009	1.16 to 2.82
Educational Level				
None	0.612	1.845	0.012	1.14 to 2.98
Basic	-	1	-	-
Secondary	0.080	1.083	0.692	0.73 to 1.61
Tertiary	-0.231	0.793	0.447	0.44 to 1.44
Age				
18 – 29	0.465	1.591	0.024	1.06 to 2.38
30 – 39	0.681	1.977	0.002	1.28 to 3.04
40 – 49	-	1	-	-
50 – 59	1.170	3.222	0.000	1.93 to 5.39
60 – 72	0.148	1.159	0.817	0.33 to 4.05
Day of Week				
Saturday	-	1	-	-
Sunday	-0.314	0.730	0.244	0.43 to 1.24
Monday	-0.444	0.642	0.154	0.35 to 1.18
Tuesday	-0.727	0.483	0.065	0.22 to 1.05
Wednesday	0.318	1.375	0.158	0.88 to 2.14
Thursday	-0.803	0.448	0.000	0.29 to 0.70
Friday	-0.536	0.585	0.008	0.39 to 0.87
Driver Category				
Private	-	1	-	-
Commercial	-0.527	0.590	0.021	0.38 to 0.92
Constant	-2.234		0.000	

According to Table 1, with the exception of Wednesday, there appears to be a general reduced likelihood to drink-drive on most days of the week compared with Saturday. The logistic regression model predicts a significant reduced propensity of being drunk among drivers whose BrACs were measured on Thursdays p<0.001 and Fridays p=0.008 when compared with Saturdays drivers. The apparent reduction of the likelihood of being drunk was not however statistically significant for Sunday p=0.244 and Monday p=0.154 when compared with the referent day (Saturday). Also, the apparent higher odds for being observed as an intoxicated driver on the roadway on Wednesday was not statistically different from Saturday p=0.158.

Finally, commercial car drivers had 41% lower rate of drink-driving compared with private car drivers p=0.021.

Relationship between drink-driving and road traffic crashes

Crash data for 2010 was analyzed for settlements and road sections for which randomize breath test data were collected. In total, 5,365 independent road traffic crashes occurred in the study areas out of which 841(15.7%) were fatal, 1,554(20.1%) were serious injuries requiring at least a 24-hour hospitalization, 1,554(29%) were minor injuries which required only out-patient treatment whilst 1,889(35.2%) resulted in property damage only crashes. In the bivariate logistic regression analysis, the damage only crashes were omitted from the data set. Dichotomous dependent variable accident severity (fatal versus non-fatal) was created and used in the bivariate model whilst the proportion of drivers exceeding the legal BAC was left as a continuous covariate.

Table 2: Association between drink-driving and road traffic injuries

Accident Severity	Logit	Odds Ratio	P - value	95% CI of logit
Percentage of Drivers exceeding legal BAC Level	0.0369	1.038	0.000	0.026 - 0.048
Constant	-2.064			-2.211 to -1.916

As illustrated in Table 2, there was a significant relationship between the proportion of drivers exceeding the legal BAC and road traffic fatalities p<0.001. On the whole, a 1% increase in the proportion of drivers exceeding the legal BAC is associated with a corresponding 4% increase in road traffic fatality, 95% CI=3% to 5%. This implies that, a reduction in the proportion of drivers exceeding the legal alcohol limit by 1% or 2% might respectively lead to a 4% or an 8% reduction of road traffic fatality in Ghana.

DISCUSSION

The roadside prevalence of drink-driving in Ghana is 5.5%. Drink-driving above a legal limit of 0.08% of this magnitude is very high because in countries where similar roadside breathalyzer studies have been conducted showed prevalence rates between 2.9% and 3.7% of drink-driving in the US (Chou et al., 2005; Chou et al., 2008) and 2% in Thailand (Ingsathit et al., 2009). The roadside prevalent rate of 3 to 4% in the US resulted in about 40% of alcohol related fatality in that country. The magnitude of the impact of drink-driving traffic crashes in Ghana could be potentially higher. Mock et al., (2001) reported an impaired driving rate of 7% in Ghana which is statistically not different from the current prevalence rate. The main reason why drink-driving prevalent rate has remained higher over time in Ghana is due to weak enforcement. Countries which have registered significant declines in drink-driving have achieved this through consistent enforcement of the drink-driving traffic law. The success of the enforcement is premised on deterrence theory which fundamental attributes are certainty of apprehension, swiftness and severity of punishment (Freeman & Watson, 2006, 2009; Watling & Freeman, 2011; Watling, Palk, Freeman, & Davey, 2010). It was determined in the study that over 95% of drivers have never been tested for alcohol on the roadway during their lifetime driving suggesting low level of enforcement. Our study predicts a potential reduction of 4% in traffic fatality associated with a 1% decline in the proportion of drink-driving on the roadway. Thus, to achieve declines in drink-driving related traffic crashes and fatalities, it is recommended to increase random breath testing on the roadways.

The probability of drivers who tested positive of alcohol to exceed the legal alcohol limit of Ghana is 64% indicating the overwhelming tendency for episodic drinking among Ghanaian drivers. This is partly because unlike the developed countries, Ghana has not defined standard drinks on the bottles of alcoholic beverages and drivers who have the urge to drink and drive anyway do not know the number of standard drinks that will reach the legal BAC and for that matter permissible for drivers. For instance, when drivers who tested positive were asked about the number of drinks they had consumed on their drinking sprees in Ghana, they answered by saying they drank two calabashes of palm wine or two pots of pito or three bottles of beer. These units of measure are too arbitrary and therefore unscientific to be relied upon for determining the amount of alcohol an individual has consumed. Conversely, in the industrialized countries, people count the amount of alcohol they have consumed in terms of standard drinks. It is therefore recommended that Ghana should define what a standard drink is in their context and enforce that standard drink labels are embossed on each kind of drink on the market.

Formal education is associated with a significantly lower likelihood of drink-driving compared with drivers without any formal education. The likelihood of observing a drunken driver is 1.8 times higher among drivers with no formal education compared drivers with basic education. The incidence of drink-driving was however not statistically distinguishable between one educational level and another. It appears drivers with formal education qualification have a better understanding and appreciation for the impairing effects of alcohol and the concomitant higher accident tendencies of drunken drivers thus engendering their higher sobriety levels compared with drivers without formal education (Abikoye, 2012). It is recommended that drivers should be given periodic education on the legal BAC limit and the harmful effects of drink-driving in the media.

Among the vehicle types observed, only bus drivers recorded lower likelihood of drink-driving compared with car drivers. Two wheeler riders and truck drivers had elevated drink-driving rates relative to car drivers. This might be one of the reasons accounting for truck drivers' over involvement in road traffic crashes and fatalities. Contrary to the general perception that commercial drivers have higher propensity to drink and drive in Ghana, private car drivers are the worst offenders of impaired driving.

It was evident in our results that the youngest age categories of drivers, the 18 – 29 and the 30-39 year olds, have elevated propensity of drink-driving compared with the 40 – 49 year olds. In corroboration with findings from the advanced countries, episodic drinking is associated with the youth and has resulted in their over involvement in alcohol related crashes (Clarke, Ward, & Truman, 2005). The advanced countries have therefore outlined strategies aimed at combating high rates of drink-driving in general and for the young drivers in particular. One of such policies is increasing the minimum legal drinking age (MLDA) for drinking alcohol in the country until age 21 or above. Research have found the MLDA to be a successful programme in reducing young drivers' alcohol related accident rates significantly (Hingson, Heeren, Levenson, Jamanka, & Voas, 2002; McCartt, Hellinga, & Kirley, 2010; Tomas Dols et al., 2010; Wrechsler, Lee, Nelson, & Lee, 2003; Zarajsek & Shope, 2006). This policy has been proven to have a positive effect on drink-driving and its related traffic crashes in two dimensions. Firstly, according to (Begg & Langley, 2001) many young people mature from their youthful impulsivity after age 26 and if by this time they have never tasted alcohol, may end up not drinking alcohol at all throughout their life time. Secondly, the turbulent adolescent behaviour might pass before the drinking law permits them to taste alcohol. Crossing over adolescence and young adulthood without drinking alcohol will ultimately prevent potential alcohol related traffic crashes among this age group.

Conclusion

A significant association between roadside alcohol prevalence and road traffic fatalities has been established. In order to reduce drink-driving prevalence and its attendant road traffic crashes, it is recommended that the country should scale-up randomized roadside breath testing programme, define standard drink and disseminate this to the populace through intensive media education, increase the minimum legal drinking age to 21 years, and reduce legal BAC limit for the youth to 0.05% in respect of the current legal limit of 0.08%. The prevailing legal BAC of 0.08% is on the higher side, therefore as a longtime measure, the country should consider reviewing this level downwards due to the apparent impairment at the 0.08% level.

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The *One for the Road* Group Programme for Repeat Drink/Drugged Drivers

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Abstract

Context
Alcohol-related crash deaths and injuries account for 31% of fatal road crashes in NZ (NZ), with 72% of the total caused by repeat drink drivers (Ministry of Transport, 2009, 2010), and preventing recidivists from re-offending is likely to have the greatest impact on alcohol-related crashes (Campbell, 2000; Joyce, 2000; Roadsafe Auckland, 2001).

Objectives
One for the Road is an innovative brief group intervention targeting behaviour change in repeat drink/ drugged drivers in NZ. This programme is based on best-practice research and methodology but adapted and refined into a unique structure and process for the NZ context. The group therapy process is the key, and this enables a focus on the deeper underlying issues while also featuring specific methods designed to engage with Maori and Pacific Islanders who make up over 50% of participants. Attendees are typically referred by lawyers/self prior to sentencing, Court and Probation Services as part of sentencing, or Alcohol and Drug Services during the process to have a licence disqualification lifted.

Key Outcomes
Over the last 4 years 570 'drink drivers' have graduated from One for the Road with 97% indicating they would plan to keep to a zero blood alcohol concentration when driving in future. Quantitative data indicate a low 3.5% re-conviction rate (1 in 28 graduates) over a period of 6 to 30 months post group completion (2.6% reconvicted within 6 months, 0.9% in the next 6-12 months, with no further reconvictions recorded over the next 18 months).

Discussion and Conclusions
Although the time span is relatively brief, this result is comparable with overseas evaluations of effective programmes, and with the overall reconviction rate for drink driving in NZ (estimated to be 36% over 10 year period (Dawe, 2010). Further research utilising a randomised controlled trial is required to examine and establish the efficacy of this intervention.

Introduction

Background to drink driving in NZ

Drinking and driving is a topical issue in NZ with increasing numbers of people being prosecuted. The Ministry of Transport reported 34,272 prosecutions for drink-driving in 2008 up from 29,052 in 2005 and reports show 31% of road deaths as being alcohol-related (Ministry of Transport, 2009). There is concern about the high number of people receiving a custodial sentence (inc. home detention) for traffic and vehicle related offences (including drinking and driving),11,851 in 2009 making up 19% of the total number of custodial sentences passed (Statistics NZ, 2010).

Methods of social change have been attempted to improve the situation such as increased police presence and breath testing, tougher sentencing, media shock tactics, and lowering the drink-driving limit is again on the political agenda. Yet there remain persistent drink-drivers who appear immune to these interventions and who appear to feel their behaviour is justified as 'thousands do it'. Societal attitudes are based on smaller groups and family systems, and on this basis the most effective way to bring about change in behaviour is to target the individual and their peer group. The *One for the Road* programme focuses on group work with repeat offenders, using engagement, empathy, challenging to world views, eliciting commitment to change, and promoting a zero drink/drugged driving limit.

Drink Driver Specific Programmes

Why focus on repeat drink driving?

In NZ, studies and police data indicate that at least 30% of drink drive offences in the Auckland region are committed by recidivists, and it is now generally acknowledged that preventing recidivists from re-offending is likely to have the greatest impact on alcohol-related crashes (Campbell, 2000; Joyce, 2000; Roadsafe Auckland, 2001). Levels of repeat drink-driving in NZ and other countries are generally poorly documented, but international studies generally report a range from 9% to over 30% depending on the follow-up period. Data from New South Wales indicated that overall 15.5% of drink-drivers return to court for a subsequent offence within 5 years (Trimboli & Smith, 2009).

In NZ, the Ministry of Transport (2010) reported that 27% of first time drink-drivers go on to re-offend despite the current regime of fines and licence disqualification. However, data[1] cited in the Law Commission (2009) *Alcohol in our lives – issues report* showed that 29,739 drivers had received one or more convictions for drink-driving in 2008 with 18,924 (64%) having only one drink driving conviction in 2008 and in the 10 years prior, while a further 6,973 drivers (23%) had one conviction in 2008 and one other prior drink-driving conviction either in 2008 or the 10 years prior, and finally another 2,594 drivers (9%) had three drink-driving convictions. These data imply that there is an overall reconviction rate of 36% over the 10 year period 1999 to 2008 in NZ, which appears to be high compared to overseas examples (Dawe, 2010).

One for the Road

The *One for the Road* programme was first implemented by Harmony Trust in 2008 as an ‘experiment’ to test whether a ‘brief intervention’ model would have any effectiveness with this population. Since then some 85 groups have been completed across the Auckland region. Referrals generally come from lawyers (with clients who have court cases pending), probation, court referrals, and Alcohol and Drug Services, or self referrals. The group is focused on engaging with ‘hard to engage’ clients and based on both best-practice research innovative ideas and strategies applied to the NZ context.

The Typical Group Member Profile

The following points are based on both demographic data obtained in the pre-group interview, and observations and impressions of the author and other colleagues gained in clinical work.Data obtained from the people who have attended to date has shown the ‘typical’ One for the Road group member to be: male (88%), aged 37years, has 4 ‘excess breath alcohol’ convictions, shows binge drinking and alcohol ‘abuse’ rather than dependency (59% scored 1-10, low to moderate alcohol dependency, while only 11% scored 11 or higher on the Leeds Dependency Questionnaire (LDQ), is defensive, has stored anger and blames others, is ‘pre-contemplative’ (does not think he has a have a problem), has strong justifications for his behaviour, and is equally likely to be Pakeha (European), Maori, or a Pacific Islander. Based on the authors clinical observations, these repeat offenders have developed a particular ‘mindset’ with strong and compelling reasons for justifying, rationalising, and continuing with their behaviour. These justifications assist the drink driver to ‘cope’ with feelings of guilt, shame, hurt, victimisation, alienation, and anger.

One group member described having a ‘book’ of justifications he could draw upon at any point in order to ‘feel’ better about his behaviour. These are often statements (beliefs) such as: “I only had a few…I drive better when I’m drunk…I’m the least drunk so I had to drive…It’s only around the

[1] NZ Police National Alcohol Assessment (Wellington, April 2009) (available at http://www.police.govt.nz).

corner…I don't have a drinking problem, I just have a driving problem…Where's the victim, I haven't hurt anybody"There's thousands out there that drink and drive".

Key Features of the Programme

Brief Intervention

The group is a run in an intensive style over 3 sessions with: 1/ an interview for initial engagement, warm up, and assessments,, 2/ group session 1:6 hours- to develop empathy, discrepancy/ and roll with resistance, 3/ group session 2:4 hours- to promote 'change talk', 'commitment language', support self-efficacy. We have also found the brief intensive model assists with client retention in group, with the completion rate for *One for the Road* being approximately 80% of those commencing the group.

Alcohol and other drug intervention studies support the effectiveness of a brief intervention model in motivating a client towards behaviour change (Bill Miller, 1996; Miller and Taylor, 1980), and there is much that can be done in even a single session to initiate change in alcohol use (Miller and Rollnick, 2002). In *One for the Road group sessions* the facilitators look for 'change talk' and commitment language' as indicators of motivation to change.

While the majority of group participants attend because they feel they have no choice, that is they have been told to attend by their lawyer, probation officer, Judge, counsellor with the threat of great legal sanctions or longer loss of licence, the group itself represents a window of opportunity in the process of change. *One for the Road* is focused primarily on participants firstly gaining self awareness around their use of alcohol, secondly being 'brought to' reflect on and question their attitudes towards drinking, drug use, and driving, and thirdly in gaining motivation towards behaviour change. This process involves focusing on the personality traits, attitudes, and core needs, and drives that underpin their offending behaviour.

Motivational Interviewing

The fundamental process followed in group parallels the work of Bill Miller (2002) with the 'motivational interviewing process of working towards change in a) Expressing Empathy b) Rolling with Resistance c) Developing Discrepancy and d) Supporting Self Efficacy. The idea is to take the 'window of opportunity' to walk people through the stages of change towards ongoing action by assisting them to publicly challenge and reassess their own beliefs.

Timing and Homework

The group is intentionally run prior to (Friday) and at the end (Sunday afternoon) of the weekend to be situated 'around' common drinking and using time. This brings a sense of realism into the group and a chance to test out 'learning' and homework in a practical sense. One client coming for a second session on a Sunday afternoon, remarked "I can see why you run this group when you do, and went on to speak of being tested in terms of setting boundaries around safe use the previous night".

A Therapy Group

One for the Road is a true therapy group which can be described as **experiential** (action, emotion, and activity based) rather than educational. This is more about 'being in' a situation than talking about a situation. There is a group resource booklet given to clients, and DVD's are shown but these are secondary to group process, where the group members are regarded as the 'guest speakers'.

The therapy utilised is eclectic and features motivational interviewing, Gestalt therapy, CBT, group process, transactional analysis, role play, and relapse prevention. These are all used with the goal of developing self-awareness and challenging attitudes, belief systems, and behaviour around both drink and driving choices, and around drinking. In order to do this the group is number is kept to a maximum of 10-12 people to enhance intimacy and the capacity for depth in the therapy process.

Thinking Problem vs Drinking (Drug) Problem

The pre group screening tools utilized (AUDIT – Alcohol Use Disorders Identification Tool, and LDQ- Leeds Dependency Questionnaire) indicate that only few (11%) of our group members are dependent on alcohol. This means that the majority had what is termed ‘alcohol abuse’, that they are not physically addicted to alcohol and have more of a sense of choice and potential for control around their use. They more fit the profile of ‘binge drinker’, which often results in poor decision making. However the other part of the equation lies in the belief systems and attitude- to the law, to risk taking, responsibility, planning, around safety and setting boundaries, and in this reflects in their resultant behaviour. The therapy process in group looks to challenge these beliefs. We do not necessarily advocate abstinence for all group members, but we do for some. For the others we would promote harm minimisation. One of the prime messages of the group is a ‘zero blood alcohol limit when driving’.

The Anti-Drink Driving Peer Group

Human beings have a strong drive for affiliation and we typically live in groups, work in groups, and tend to drink alcohol in groups (ie ‘social drinkers’). People also tend choose groups within which they feel normal and which serve to normalise their behaviour. Drink Drivers who don’t believe they have an ‘alcohol’ problem, are more likely to attend a group for ‘drink drivers’ than one for ‘alcoholics’. There is sense of acceptance and belonging in associating with a groups, but also in distancing oneself from another group (Allport, 1954). One of the most important objectives of One for the Road is then to establish an ‘anti drink driving’ peer group amongst the group members, where the person who remains ‘pro’ drink driving and begins to feel ‘abnormal’.

Connecting with Maori Pacific Island People

The group is designed specifically to cater for people of Maori and Pacific Islander origin (over 50%) and a feature of this is the focus on hospitality- a cooked kai (food) is provided to participants, use of karaka, observance of tikanga (protocol). Both Maori and Pacific cultures are reflected in group facilitators and leaders. The attendance of ‘drink-driver crash survivor’, Tamati Paul, Ngati Porou, and who has been through a process of rehabilitation and recovery, provides an important catalyst for change. This session is noted to parallel elements of te powhiri (first meeting ritual) process with te wero (challenge), whaikorero (speaking), whakautu (reply), and whakawhanungatanga (connecting). Participants have noted feeling shame, whakama, then a sense of aroha and forgiveness. Attendance by support people and family (whanau) is encouraged.

Evaluating the Group

Over the first 57 groups run (570 attendees) ‘end of group’ screens indicated that 80% of graduates were more ‘ready to change’ (RTC- Readiness to Change) and had a lower ‘Risk of Drink Driving’ for the future (RODD Scale- a 12 question self-report likert scale questionnaire developed by the Authors to assess attitude change within the group). Anonymous Client Group Evaluations at end of group indicate 97% of clients agreed they would keep a zero blood alcohol limit when driving in future

The most commonly used outcome measure in published repeat drink-driver evaluations is subsequent drink-driving convictions as it shows quantitative efficacy. Based on a meta-analysis by Wells-Parker et al (1995) treatment and rehabilitation with drink-drivers had on average a small but positive influence (7-9% reduction) on the incidence of recidivism and crashes, when compared with standard punitive sanctions without treatment. Data obtained from the NZ Transport Agency indicated re-conviction rates for alcohol related driving offences in the first 570 graduates from the group was a low 3.5% (or 1 in 28) over a period of 6 to 30 months post completion. In the first 6 months following group completion 2.6% had been re-convicted for drink-driving, and in the subsequent 6-12 months a further 0.9%, suggesting that relapse, if it happens, is likely to be earlier rather than later, and length of time following programme completion is not necessarily associated increased risk of re-offending. These results compare favourably with the successful New South Wales *Sober Driver* Program with a 5% re-conviction rate after 2 years (although it is important to note that this programme forms part of a systemic inter-sectorial approach to reducing drink-driving offending with coordinated sentencing and mandatory supervision programmes for participants).

The feedback from One for the Road participants also provides promising evidence as to the effectiveness of the group: *"I felt safe to be honest…I think the course was a real eye opener. I enjoyed the talking and communicating with people in the same or similar situations to myself…Tamati (Paul)was the initial kick start for change, then acknowledging the problem, asking the hard questions, confronting the problem, and making a plan to avoid drinking and driving…I felt this course has helped me and I would recommend it to others"*

Limitations

The authors are encouraged by the results given that group is a brief (and possibly stand-alone) intervention. These results compare favourably with other longer term, more costly, or more integrated programmes. However a key limitation is that the follow-up period for the programme is a maximum of 2.5 years. Further follow-up for all groups over a minimum of 3 years would be valid given that the intervention is intended to create sustainable changes to behaviour. There will also be those who may be drink-driving subsequent to group completion but just 'not yet caught' for it, and it may be a poor indication of actual drink-driving as the risk of being detected is relatively small (Health Canada, 2004). Furthermore the results of these evaluations have not been compared to a control group and therefore limit any conclusions regarding the effectiveness of this intervention in relation to people who have had no intervention.

Conclusions, findings and /or recommendations

Initial results for One for the Road are promising in terms of the low reconviction rates and while the time elapsed to date is relatively short, this reconviction rate is comparable with overseas evaluations of effective programmes. The low reconviction rate is more impressive given the profile of the *One for the Road* programme participants (i.e. relatively high previous drink-drive convictions and low motivation to change compared to overseas programmes, and the high proportion of Maori and Pacific participants). Also the relatively inexpensive cost of the programme indicates that the programme is likely to be cost-effective. Other positive signs regarding effectiveness include improvements in scores on the Readiness to Change (RTC) and Risk of Drink Driving (RODD) scores between pre and post programme. And positive feedback from group participants suggesting some success in the process of engaging and connecting with this at times 'hard to engage' population.

In conclusion, the *One for the Road* programme shows promise in an area that has been inadequately addressed in NZ to date. The programme shows a distinctive NZ flavour and a true therapeutic focus. It appears effective in working with 'hard to engage' and complex offenders, who without intervention are highly likely to reoffend causing harm to themselves or others. However further research utilising a randomised controlled trial is required to examine and establish efficacy.

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An assessment of criteria used in Switzerland to refer drunk driving offenders for medical screening

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Abstract

Keywords
Traffic medicine; Via Sicura;BAC; Drunk driving offenders; Swiss criteria.

Background
According to Swiss law, several criteria are defined to identify drunk drivers for medical and/or psychological assessment to rule out an alcohol problem. Those criteria are: first time drunk driving offenders with blood alcohol concentration (BAC) ≥2.50 g/kg (criterion 1), second-time drunk driving offenders with BAC ≥1.60 g/kg in five years (criterion 2), or third-time drunk driving offenders with BAC ≥0.80 g/kg in ten years (criterion 3). The expert uses these criteria to determine whether the patient is fit or unfit to drive. In case of unfitness, a specialized alcohol treatment follow-up is mandatory for the individual to recover his/her driver's license.

Aims
To assess the Swiss criteria for referring drunk driving offenders to medical and/or psychological evaluation, and to examine the prevalence of alcohol problems in this population.

Methods
Data were collected using 209 consecutive cases of drivers who were referred according to the above described criteria between 2010 and 2012. We excluded patients under the influence of drugs and patients unfit for other medical reasons. The screening assessment involved written validated questionnaires (AUDIT, EVACAPA), a personal interview by specialized doctors and/or psychologists, additional questionnaires, information from the driver's general practitioner, and results of blood alcohol markers. The conclusion of the expert evaluation based on DSM IV criteria was classified as one of four categories: fit with conditions, fit without conditions, unfit -alcohol dependence, and unfit-alcohol abuse.

Results
Among drivers, 73 subjects (35%) presented criterion 1, 104 subjects (50%) criterion 2, and 32 subjects (15%) criterion 3. Only 38 subjects (18%) were considered fit for driving without any restrictions, and 9 subjects (4%) with conditions. The rest of drivers (78%) were considered unfit to drive (alcohol dependence (47%), alcohol abuse (30%)).

Conclusion
The criteria used for medical and/or psychological assessment are appropriate, considering the high rate of problem drinkers observed in this population.

Introduction

Swiss Traffic Law specifies which drivers are to be referred by the Cantonal Driver and Vehicle Licensing Agency to a specialized institute for expert review. The authorities require an expert review whenever impaired fitness to drive is suspected; for example, when there is evidence of addiction (from a police or medical report). A review may also be requested even if no traffic offense has been committed. In most cases, however, one or more traffic offenses indicate an impaired fitness to drive. The expert review determines the nature and severity of the impairment and a written report is submitted to the authorities.

Switzerland has set up a rigorous program to identify drunk drivers and then to refer them for medical and/or psychological assessment to determine the presence (or not) of an alcohol problem. The criteria are: first time drunk driving offenders with blood alcohol concentration (BAC) ≥2.50 g/kg (criterion 1), second time drunk driving offenders with BAC ≥1.60 g/kg in five years (criterion 2), or three time drunk driving offenders with BAC ≥0.80 g/kg in ten years (criterion 3).

In the Canton of Vaud (French speaking Switzerland, 800,000 inhabitants), fthe UMPT (Unit of Psychology and Traffic Medicine) in Lausanne has monitored fitness to drive for many years. When inability to drive is presumed for medical, psychological or psychiatric reasons, the unit is asked to prepare an expert evaluation for the Department of Motor Vehicles and Navigation (SAN). After this assessment, the expert determines whether the driver is considered unfit to drive, fit to drive, or fit to drive only under conditions. In the last case, appropriate restrictions are recommended; for example, abstention from alcohol and/or drugs. Conditions related to treatment may also be imposed. In case of unfitness, the driver is required to undergo a specialized follow-up in order to recover his/her license to drive.

On June 15, 2012, the Swiss Parliament adopted the Road Safety Programme "Via sicura." The Federal Council decided to put the measures contained therein into force in a progressive manner. The first application will take place January 1, 2013. A second will occur early in 2014. In Spring 2014, a consultation process with the cantons and interested organizations will be conducted. From January 1, 2014, an expert evaluation is required in cases of driving with BAC ≥1.60 g/kg. The third part contains measures that need more time to prepare. This is mainly due to the adaptation of IT systems at the federal and cantonal level. They can therefore only be set from 2015.

Methods

This retrospective study was carried out in order to analyze the 2010-2012 data from all 209 consecutive cases of drivers who were apprehended by the police for driving under the influence of alcohol and who were referred for an expert examination in our Unit. We excluded patients who were arrested also for driving under the influence of drugs or medication and patients who had other specific pathologies (psychiatric or somatic disease) incompatible with driving. The following information was obtained from the Institute's records: diagnosis by the traffic safety expert, number of drunk driving offenses, BAC level.

The screening assessments involved written validated questionnaires: AUDIT (Alcohol Use Disorder Identification Test), a questionnaire developed by WHO that identifies individuals along the full spectrum of alcohol misuse and hence provides an opportunity for early intervention in non-specialty settings, and EVACAPA (Evaluation of an action for drivers having a problem with alcohol). The individual underwent a structured diagnostic interview, as well as a personal interview by specialized doctors and/or psychologists, completed significant additional available written questionnaires, and a blood alcohol analysis was done. In addition, with his/her written consent, information from the driver's general pratictioner (when available) was also used in the screening process. All cases were evaluated by two experts, and each case was supervised by the same manager. The conclusion of the expert evaluation was classified into one of four categories: fit (absence of problem with or without conditions) or unfit to drive and the specific reason for unfitness is given (alcohol dependence or alcohol abuse). The diagnostic terms used in this study were taken from the traffic safety expert reviews. Alcohol dependence/abuse was the term used to define patients with either alcohol abuse or dependence. The criteria for DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition) were used as the reference standard for alcohol dependence and alcohol abuse. According to individuals' responses, they were classified into DSM-IV categories as alcohol abuse, alcohol dependence or absence of problem. However, in contrast with the DSM-IV, wich focuses more on the effects of alcohol abuse on an individual's health, the expert diagnosis of abuse here is determined with regard to excessive alcohol consumption and its relevance to road traffic. Therefore the diagnosis may be used when there is a least one existing DUI offense and the consumption is of ≥21 standard drink units (SDU) per week for males (equivalent to 210g ethanol), and ≥14 standard drink units per week (equivalent to 140g ethanol) for females.

Results

Socio-demographic and alcohol-related data

1,316 individuals were assessed for eligibility, out of which 1,107 were excluded for various reasons (we excluded patients who were arrested also for driving under the influence of drugs or medication and patients who had other specific pathologies (psychiatric or somatic disease) incompatible with driving). A total of 209 individuals were chosen for our study. The socio-demographic characteristics are presented in Table 1. There was a clear predominance of males (93.3%). According to DSM-IV, drinkers were classified as absence of alcohol problem or fit to drive (n=47; 59.5%), alcohol abuse (n=63; 30.1 %), alcohol dependence (n=83; 39.7%) and alcohol abuse/dependence (n=16; 7.7%).

Prevalence of alcohol problems according to Swiss criteria

The prevalence of alcohol problems according to Swiss criteria from all drivers investigated in our unit is shown in Table 2 (N and %). The distribution of fit to drive and unfit to drive individuals is shown in Table 3. Among drivers, 73 subjects (35%) presented criterion 1, 104 subjects (50%) criterion 2, and 32 subjects (15%) criterion 3. Only 38 subjects (18%) were considered fit to drive without any restrictions, and 9 subjects (4%) with conditions. The rest of the drivers (78%) were considered unfit to drive (alcohol dependency (47%), alcohol abuse (30%)). The highest BAC was 3.26 g/kg (criterion 1), 2.48 and 3.17 g/kg (criterion 2) and 1.72, 2.37 and 2.17 g/kg (criterion 3). The lowest BAC was 2.50 g/kg (criterion 1), 0.87 g/kg and 1.14 g/kg (criterion 2), and 0.61 g/kg, 0.70 g/kg and 0.76 g/kg (criterion 3).

Discussion

Data were collected using 209 consecutive cases of drivers who were referred according to the above described criteria between 2010 and 2012 (Figure 1). Numerous studies have demonstrated that problem drinkers (hazardous drinking, alcohol abuse and alcohol dependence) can benefit from medical intervention, but lack of recognition of alcohol related problems by primary health care workers has been frequently reported.

Conclusion

This study will contribute to improving our understanding of the alcohol and driving problem in Switzerland, and could encourage policymakers and politicians to develop enforcement strategies and improve public awareness of the relationship between drunk driving and BAC. The criteria used by Swiss experts for medical and/or psychological assessment are appropriate, considering the high rate of problem drinkers observed in this population. The results will help shape preventive approaches to drinking and driving in Switzerland.

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Table 1. Socio-demographic characteristics and alcohol diagnostic classification (according to DSM-IV)

	MALE	FEMALE	TOT
ABUSE	61	2	63 (30.1%)
DEPENDENCE	74	9	83 (39.7%)
DEPENDANCE/ABUSE	14	2	16 (7.7 %)
FIT TO DRIVE	46	1	47 (22.5%)
Total	**195 (93.3%)**	**14 (6.7%)**	**209**

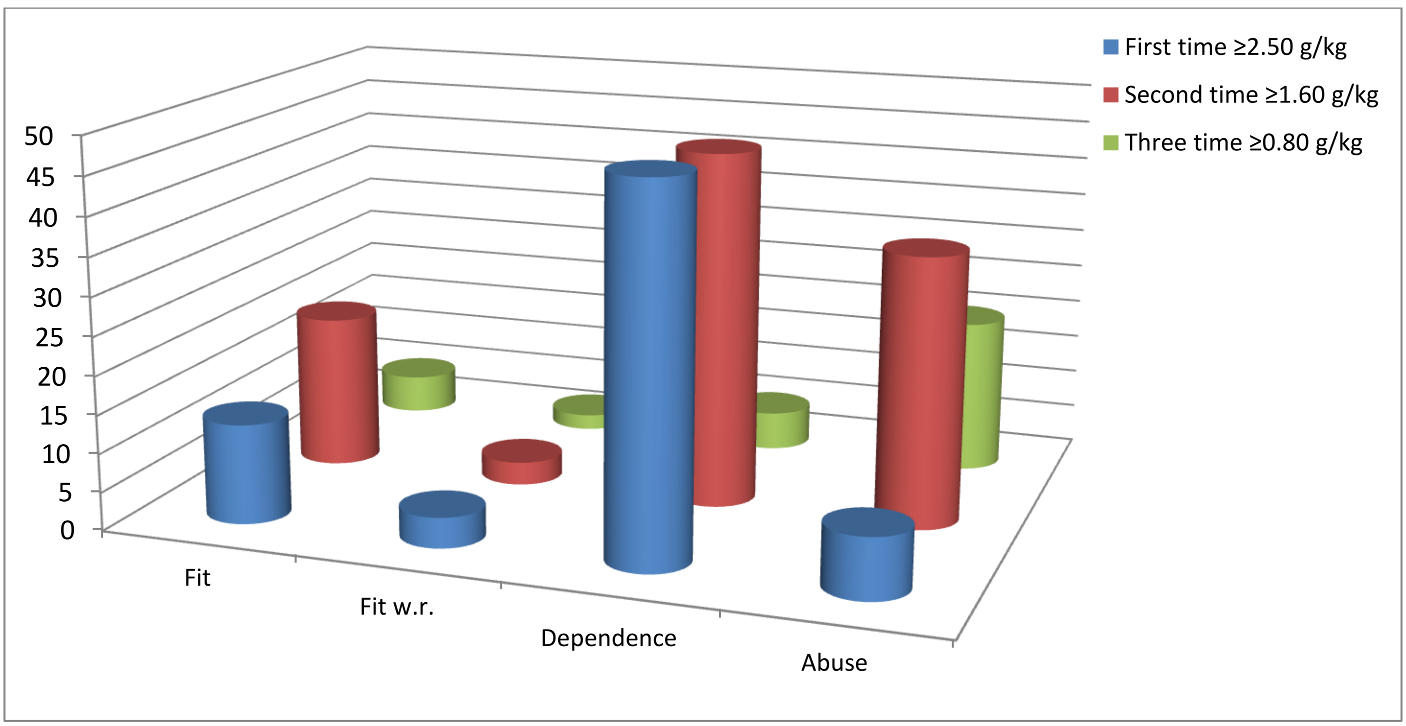
Table 2. Prevalence (N et %) of alcohol problems according Swiss criteria

Criteria		N	**Fit**	Fit	Fit w.r.	**Unfit**	Addiction to alcohol	Abuse
1	First time ≥2.50 g/kg	73 (35%)	**17 (23%)**	13 (18%)	4 (5%)	**56 (77%)**	48 (66%)	8 (11%)
2	Second time ≥1.60 g/kg	104 (50%)	**23 (22%)**	20 (19%)	3 (3%)	**81 (78%)**	46 (44%)	35 (34%)
3	Three time ≥0.80 g/kg	32 (15%)	**7 (22%)**	5 (16%)	2 (6%)	**25 (78%)**	5 (16%)	20 (63%)
		209 (100%)	**47 (22%)**	**38 (18%)**	**9 (4%)**	**162 (78%)**	**99 (48%)**	**63 (30%)**

Table 3. Distribution of patients among fit to drive condition and unfit to drive condition

Criteria		N	**Fit**	Fit	Fit w.r.	**Unfit**	Addiction to alcohol	Abuse
1	First time ≥2.50 g/kg	73	100%	76%	24%	100%	86%	14%
2	Second time ≥1.60 g/kg	104	100%	87%	13%	100%	57%	43%
3	Three time ≥0.80 g/kg	32	100%	71%	29%	100%	20%	80%
		209	**100%**	**81%**	**19%**	**100%**	**61%**	**39%**

Figure 1



How to prescribe and dispense driving impairing medicines: application of the DRUID materials in software for physicians and pharmacists

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Abstract

Background: The assessment of whether a patient is medically fit to drive can be addressed by physicians under various conditions (e.g. neurological disorders). But also if they prescribe medications that can cause significant adverse effect across a range of skills required for safe driving. Patients in most situations will obtain their medications dispensed by pharmacists who, similar to physicians, have a responsibility to provide the patient with information as how to use the medication safely.

Aims: To illustrate the added value of the DRUID categorization system after implementation of the DRUID system (e.g. in computer systems for prescribing physicians and dispensing pharmacists).

Methods: Based on DRUID materials an intervention study was carried out in Belgium, the Netherlands and Spain, in which electronic provision of relevant information (as a stand-alone tool or integrated in the software packages used in daily practice) to select the least impairing medicine within a therapeutic class, if available, was provided during prescribing and dispensing of driving impairing medicines.

Results: The implementation of computerized guidelines and DRUID categorization was highly accepted by both physicians and pharmacists and participants. For physicians significant increase in reported behaviour was found. On the contrary, no significant differences in actual knowledge and attitudes were revealed. For pharmacists attitudes and awareness were significantly more positive after the implementation of DRUID information. Significant increase in reported behaviour and actual knowledge was found.

Discusion and conclusion: Health care professionals can improve their prescribing and dispensing practcies if supported by DRUID materials (in particular by offering integrated software applications). Dispensing support tools with information on the potential impairing effects of medicines on the fitness to drive increases awareness, reported risk communication behavior as well as knowledge of pharmacists.

Introduction

The main goals of DRUID Work Package 7 were the development of guidelines for healthcare professionals and on risk communication aimed at different target groups based on DRUID outcomes (see www.druid-project.eu) .

The following objectives focusing on improving prescribing and dispensing practices regarding driving impairing medicines were pursued in DRUID WP7:

- Reflections on improvements of procedures for assessing fitness to drive;
- Development of prescribing and dispensing guidelines for physicians and pharmacists to select the least impairing medicine within a therapeutic class and to inform a patient meeting his/her needs;
- Evaluation of practice guidelines and protocols in every day medical and pharmaceutical practice by focussing on different practice models, with and without the application of Information and Communication Technologies (ICT).

Professional Guidelines and Standards

A questionnaire survey among driving licensing authorities and experts was conducted in 29 European countries (all EU member states, Switzerland, Norway) in order to obtain better insights into the current situation in Europe concerning guidelines for physicians on prescribing medicines with impact on driving performance and on assessing fitness to drive (Deliverable 7.2.1; see www.druid-project.eu). In addition, existing guidelines for pharmacists on advising patients while dispensing those medicines were considered (Deliverable 7.2.2).

Based on the feedback on the questionnaire, an overview of the current European regulations and guidelines is presented. Concerning prescribing and dispensing of psychotropic medicines, which might have an impact on the driving performance, it was concluded that strict and binding regulations are the exception rather than the rule. The compiled guidelines are typically recommendations, not regulations. The role, responsibilities and tasks of physicians and pharmacists are not defined uniformly. Despite the great diversification of recommendations in the different countries one can deduct a common denominator. Physicians and pharmacists usually should give their patients the most comprehensive and adequate advice on medicines and their effect on driving performance. This includes a request of not leaving the patient alone with the decision whether to drive or not while using medicines.

In most cases physicians and pharmacists will not be made legally responsible in case an accident happens to one of their patients under a certain medication. But they are advised to keep a proper record of the consultation, as they might be sued in civil court cases (by insurance companies).

The regulations in the different countries dealing with the procedures of assessing fitness to drive are mainly in line with the European Council Directive (91-439-EEC) for issuing and renewing driving licenes. Practical implementations and the assignment of responsibilities differ from country to country. It is very difficult to derive a “best practice” from the present results.

Several opportunities to improve guidelines and procedures for assessing fitness to drive are presented based on the progress made within DRUID Work Packages 4 and 7. Several reflections on the existing guidelines and regulations, in particular on the text of Art 15 of Council Directive 91-439-EEC, resulted in 8 recommendations.

Some of the recommendations point at the vague terms that are used in Article 15 (such as "substance abuse", "regular use", both for medicines and illicit drugs, etc.), whereas more internationally accepted terms exist. It is also recommended to include the underlying cause or reason for taking medicines, as well as all co-morbidity factors, while assessing fitness to drive. Another recommendation points at the term "combinations of medicines with central nervous system activity". It is emphasized that combinations of psychotropic medicines with other medication that can alter the metabolism of the psychotropic medicine (with a possible consequence of increased blood levels of the latter) will always call for an individual judgement by the prescribing physician. This is especially of interest for drivers with co-morbidities and in case of polypharmacy.

It is also recommended to apply the DRUID categorization system for medicines affecting driving performance in developing national requirements on fitness to drive.

Finally it is recommended that in situations where physicians will advise a patient to start driving again after a period in which the advice was given not to drive while using the medicine, specific procedures are needed to structure the consultation and to manage the risk of litigation in case an accident could occur.

It will take special efforts to derive a consensus at a European level for the use of terms and procedures that allow improvements for assessing fitness to drive. Therefore it is recommended that working groups and expert rounds should discuss the DRUID recommendations involving physicians, pharmacists, driving licensing authorities and policy makers (Deliverable 7.2.1 and Deliverable 7.2.2; see www.druid-project.eu).

Application of the DRUID categorisation system in communicating risk to patients who drive and use driving impairing medicines

The DRUID categorisation system should also be used as a tool to motivate health care professionals (HCPs) to provide patients with clear information, communicate to patients the risk associated with driving under the influence of medicines, and start HCP-patient discussion leading to both safer prescriptions and the patient's conscious decision whether to drive or not . From the patient point of view, this classification could play an active role in helping them to be involved along the decision-making process, to understand the hazards of some medications to road safety, and to remind them to use caution while driving until their individual responses to the therapy have been well established.

It has been recommended to use the categorisation system for defining specific warnings for patients (Table 1). Especially at the start of treatment more tailor-made consultation to patients will be needed to decide on the adverse side effects on driving performance. It was suggested that the DRUID guidelines would change the HCPs knowledge, attitudes and reported behaviour and encourage them to be more reflective to the problems patients could encounter while using their medicines as drivers. It was also made clear that application of these guidelines would be more effective if made available in the daily process of prescribing and dispensing driving impairing medicines.

Methods

The effectiveness of the implementation of developed protocols and guidelines on the attitude, knowledge and reported behaviour of healthcare professionals' (physicians, pharmacists, nurses) in clinical practice were evaluated via two different approaches: i) by using an integrated (ICT) tool (additional software integrated into the ICT software used by

Table 1: DRUID Categorization system for medicines and driving.

Information for physicians and pharmacists		**Warning for patients** (with warning symbols and standard descriptions per country)
Description of categories with levels of impairment	**Information on how to advise their patients**	
Category 0 Presumed to be safe or unlikely to produce an effect on fitness to drive.	Confirm that the medicine will be safe for driving, provided that combinations with alcohol and other psychotropic medicines are excluded.	[no warning needed]
Category I Likely to produce minor adverse effects on fitness to drive.	Inform the patient that impairing side effects may occur especially during the first days and that have a negative influence on his/her driving ability. Give the patient the advice not to drive if these side effects occur.	**Warning level 1** Do not drive without having read the relevant section on driving impairment in the package insert.
Category II Likely to produce moderate adverse effect on fitness to drive.	Inform the patient about the possible impairing side effects and the negative influence on his/her driving ability. Advise the patient not to drive during the first few days of the treatment. If possible prescribe a safer medicine, if acceptable by the patient.	**Warning level 2** Do not drive without advice of a health care professional. Read the relevant sections on driving impairment in the package insert before consulting the physician or pharmacist
Category III Likely to produce severe effects on fitness to drive or presumed to be potentially dangerous.	Inform the patient about the possible impairing side effects and the negative influence on his/her driving ability. Urgently advise the patient not to drive. Consider prescribing a safer medicine, if acceptable by the patient.	**Warning level 3** Do not drive. Seek medical advice after a period of treatment about the conditions to restart driving again.

* The assigned categories relate to the acute or first time use of the medicine (at the start of treatment)

professionals in daily practice; country specific development) and ii) by using a non-integrated tool for presenting the protocols and guidelines (ICT tool developed within the framework of the project).

The target populations were health care professionals in the primary care setting: i) physicians (Belgium, Spain), ii) pharmacists (Belgium, the Netherlands, Spain) and iii) Nurses (Spain). In addition, a “pure” control group was added to evaluate the effectiveness of current practices with no DRUID-relevant information.

Participants were introduced to the tools/software(s) through a training scheme. Some of the participants did not receive training (e.g. the integrated group of physicians (SoSoeMe)). In addition, participants were informed about the DRUID guidelines regarding driving and medicines intake. The time sequence involved a standard procedure of recruitment, briefing, and consent. Participants filled in the pre-questionnaire at the start of their training and a post-questionnaire after six months of using the DRUID guidelines in their practice. They used the software during their daily practice for either prescribing or dispensing medicines depending on the professional groups they belonged to. After the testing period ended they filled in a post-questionnaire in order to evaluate the effectiveness of the tool and the applied guidelines (Deliverbale7.4.1 and Deliverable 7.4.2).

Results

The country studies showed that almost 74% of participants received no education regarding medicines and driving during their academic studies and their professional participation in post-graduate education. The information received during the training did change their knowledge about the potentially detrimental effects of medicines on driving fitness for more than half the participants (55%).

For pharmacists positive changes in attitude, self-reported behaviour and knowledge were measured mostly if the DRUID information was used integrated in their daily used software (Legrand et al, 2012). These pharmacists (Belgian study) asked significantly more about the patients’ driving experience, informed them more about driving related risk and impairing effects of the medicines. The knowledge on the topic ‘medicines and driving’ remainded generally low.

After the implementation of DRUID guidelines, a 10% increase in the positive change of reported behaviour was observed in the overall physicians’ samples across the country studies. Patients visiting pharmacists in the intervention group (Dutch study) were significantly better informed about driving impairing effects of their medication, but did not change their driving behaviour. The majority of patients (83.4%) visiting a health service or pharmacy (Spanish study) would reduce frequency of driving, if a prescribed medicine has the warning pictogram on the package.

Discussion and conclusions

The application of DRUID guidelines was successful and shows the readiness of health care professionals to adopt them. The findings support the statement that guidelines are important and can improve the quality of health care. Physicians and pharmacists have shown a change in behaviour after the implementation of DRUID guidelines, therefore these guidelines could be successfully incorporated in existing decision support systems. These guidelines fill in an important "gap" linking prescribing and dispensing of medicine with both patient and road safety. Physicians are affected by the DRUID training. However, this training should not be a short-term endeavour, but flexible, adaptable, and personalized to local settings.

Based on the comments made by the health professionals within the country reports, the implementation of computerized guidelines and DRUID categorization was highly accepted as practical information by both physicians and pharmacists and participants were willing to continue using the DRUID information if integrated in their prescribing and dispensing computer systems for easier incorporation in their daily practices. Participants offered ideas for future developments such as inclusion of other medicines in the categorization scheme and the adaptation of information to the native language. Future recommendations should also include specialized and elderly directed advices incorporated in the system and adaptation to other target groups and not only drivers (e.g. heavy machinery usage and seniors information).

A long term goal would be to evaluate the impact of guidelines on the health care system, various stakeholder groups and to compare it with other studies' findings. In addition, further research could facilitate adaptation and customization of guidelines for different groups of health care professionals and national settings. A set of DRUID recommendations has been derived from the main conclusions of both composite cross comparisons and country studies. The key message is clear about the necessity of diffusion of DRUID information to physicians, pharmacists, and nurses in all clinical settings.

It is concluded that health care professionals can improve their clinical practices if supported by DRUID materials (in particular by offering integrated software applications). Dispensing support tools with information on the potential impairing effects of medicines on the fitness to drive increases awareness, reported risk communication behavior as well as knowledge of pharmacists.

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Examining age- and sex-related risk factors in first-time DWI offenders

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Background
DWI research has focused on younger males, consequently much less is known about female and older offenders. Quebec data demonstrate a bimodal distribution in first-time driving while impaired (fDWI) offences, a pattern also observed internationally. Males' fDWI offences peak between the ages of 18 to 25 with a second smaller peak between 35 to 44. In contrast, females' fDWI offences peak between 36 to 47 with a smaller peak between 20 to 27. These observations suggest that the trajectory to fDWI offending is influenced by interactions between sex and age.

Aims
This preliminary study explores how sex and age may interact to influence the trajectory to fDWI through patterning of alcohol consumption, psychological adjustment, and impulsivity.

Methods
Individuals arrested for a fDWI within the past two years were recruited. Participants were administered the AUDIT, Timeline Follow Back, MCMI, UPPS, and Stoplight and Balloon Analog Risk Tasks.

Results
Thirty-six participants were recruited: younger females (n = 9, mean age = 23.22, *SD = 2.22*), younger males (n = 12, mean age = 21.67, *SD* = 2.43), older males (n = 12, mean age = 40.08, *SD* = 6.31), older females (n = 3, mean age = 43.67, *SD* = 2.08). Younger females engaged in more binge drinking, endorsed greater symptoms of alcohol misuse, and scored higher on urgency than both younger and older males. No significant findings were observed between older females and all other groups.

Discussion and conclusion
fDWI offending among younger females appear to be related to binge drinking and emotion-related impulsivity. Younger females appear to be different than male offenders of all ages. The findings suggest that female fDWI is not analogous to male fDWI, a postulate that may need to be considered for intervention/prevention efforts with female fDWI offenders.

Introduction

Road traffic crashes (RTCs) are the 9th leading global cause of death, and are predicted to represent the 5th leading cause by 2030. Young people are particularly vulnerable: RTCs are the leading cause of death worldwide among youth (Mathers & Loncar, 2006; WHO, 2008). Female involvement in first-time DWI (fDWI) behaviour is of increasing concern. The gender gap for fDWI offences is closing; based on observations in the U.S. from 2001 to 2010, male offences have decreased by 10.7% while female offences have increased by 35.9% (Federal Bureau of Investigation, 2010). Overall, while the impaired driving rate is half of what it was 25 years ago, further declines have stalled, and the current rate is the highest it has been in the past decade (Perreault, 2013).

Distinct patterns in the frequency distributions of fDWI offences by age and sex are seen in Quebec data from 2003 to 2008, depicted in Figure 1, which are consistent with international statistics (e.g., (Jones & Holmgren, 2009). Males, especially younger males are overrepresented in Quebec's fDWI events, whereas females represented approximately 15% of fDWI cases. Moreover, male fDWI offences peak between the ages of 18 to 25 and decrease thereafter. Rates rise once again at 35 to peak a second time at 44 years of age. A different bimodal distribution is observed among females. Rates for females peak between the ages of 36 to 47 with a smaller peak observable from 20 to 27. These observations suggest that the trajectory to fDWI offending is moderated by both sex and age. Given these sex differences, research on male offending may not accurately generalize to female offending. More exploration of female offending is warranted.

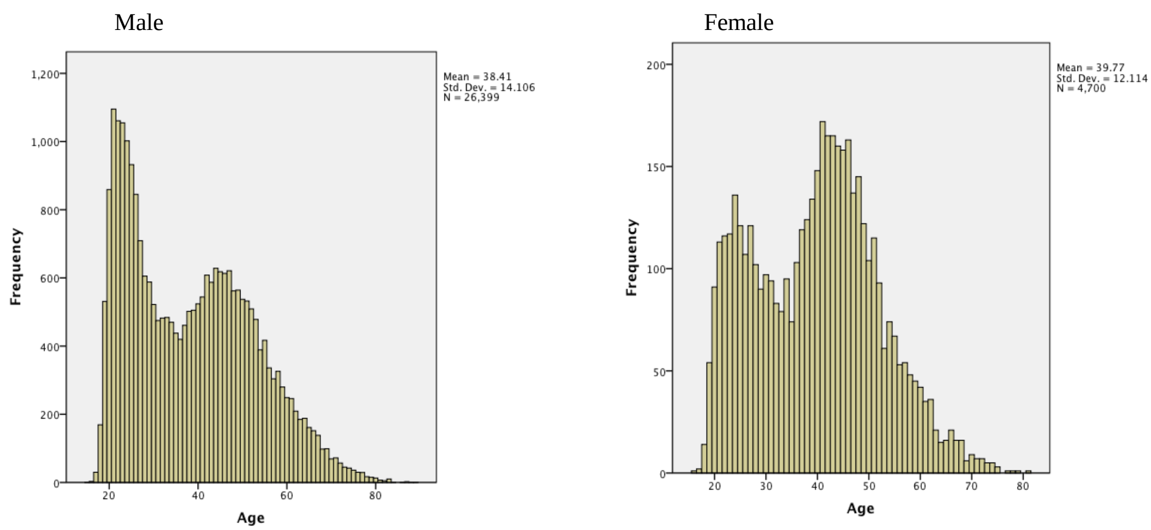

Figure 1. Quebec, Canada population data of first-time DWI offences for males and females by age between the years 2003 and 2008.

The purpose of this research project is to investigate potential age and sex moderation effects and interactions on the trajectory to a fDWI arrest.

Alcohol consumption and DWI

Alcohol misuse is a sentinel feature of DWI behaviour (Flowers et al., 2008/4). DWI offenders compared to the general population consume alcohol more frequently, consume greater quantities in one occasion, are more likely to meet criteria for an alcohol use disorder (AUD), and experience more alcohol-related problems (Nochajski & Wieczorek, 2000). Binge drinking is a pattern of alcohol consumption most associated to DWI, with 84% of U.S. DWI events accounted for by binge drinkers while 35% of DWI events were accounted for by heavy drinkers (Flowers et al., 2008/4). Of the patterns of alcohol consumption, binge drinking appears to be the riskiest pattern leading to a fDWI.

Age-related differences in alcohol consumption and DWI

Different alcohol consumption patterns are more prevalent in certain age groups than in others. In the DWI population, the highest prevalence of binge drinking tends to be among young individuals between the ages of 18 to 24, whereas individuals 40 years of age and older tend to have the highest prevalence rate of heavy drinking not involving binging (Flowers et al., 2008/4; Jackson & Chung, 2011). These patterns of alcohol consumption might be reflected in different levels of risk, with binge drinking possibly representing the greatest risk for younger drivers.

Sex-related differences in alcohol consumption and DWI

Males drink in ways that are different than females. In North America, females have an overall lower prevalence rate of AUD (i.e., 2.3% of females and 8.2% of males) (Rehm et al., 2009). Within the fDWI population, the prevalence rate of lifetime diagnosis for AUD is 85% and 91% for females and males respectively (Lapham et al., 2001). Even though the female AUD prevalence rate is still lower than males', the gap between females and males is much smaller. The proportion of female AUD in the fDWI population is significantly higher than female AUD in the general population, while the proportion of male AUD between both populations does not vary as much. It is therefore possible that AUD may be the primary risk factor for fDWI specifically among females.

Sex-related differences in symptoms of psychopathology and DWI

Literature has been fairly consistent in suggesting that females' self-medicating with alcohol serves to alleviate and cope with distressing symptoms. In the fDWI population, females meet criteria for non-substance related psychiatric disorders (i.e., mood and anxiety disorders) at a higher rate than males (i.e., 50% of females and 33% of males) (Lapham et al., 2001). Drinking as a maladaptive coping mechanism for symptoms of psychopathology may be more representative of female offending than male offending.

Impulsivity and DWI

Heightened impulsivity is a consistent characteristic observed in DWI as it is related to risk-taking behaviour and poor decision-making (Zuckerman, 1979, 1994). Impulsivity is a multidimensional construct defined as engaging in behaviours quickly and without forethought (Whiteside & Lynam, 2001). Certain forms of impulsivity might be more prevalent or predictive in different samples. For example, the dimension lack of premeditation has been most observed in individuals with antisocial personality disorder (Lynam & Miller, 2004). It is therefore possible that a dimension of impulsivity is most observed within the fDWI population, this insight can lend to the development of targeted intervention efforts.

Sex and age interactions in impulsivity

Sex differences in levels of impulsivity have been observed to change over time. These differences are apparent during adolescence and young adulthood but tend to diminish with age (Cross, Copping, & Campbell, 2011). Males in young adulthood engage in more driving-related risky behaviours such as speeding, and driving without a seat belt than do young female adults, an effect not observed in middle-aged groups (Liang, Shediac-Rizkallah, Celentano, & Rohde, 1999). Sex differences in impulsivity are most observable at younger ages and less so at older ages. As impulsivity plays a role in fDWI offending, it is important to explore its levels between sex and throughout age in fDWI offenders.

Conclusion

DWI represents a significant yet preventable public health concern. Males, especially younger males, are overrepresented in the fDWI offending population. However, females represent a growing fDWI subgroup. Epidemiological and experimental data suggest that different subgroups of fDWI offenders, based on age and sex, have different trajectories to fDWI offending. The examination of the influence of age and sex effects in fDWI offending is relevant to the design of more targeted interventions.

Accordingly, this study tests three main hypotheses: 1) older offenders will have a higher frequency of heavy drinking, 2) older female offenders will have the highest rate of problematic drinking related to symptoms of psychopathology, 3) younger offenders will have higher levels of impulsivity, and a higher frequency of binge drinking than older offenders.

Methods

Participants

Participants were recruited through Research Ethics Board approved newspaper advertisements and through a bank of participants who previously participated in studies at the Addictions Research Program (ARP). Inclusion criteria: 1) between the ages of 18 to 27 or between 35 to 50, and 2) arrested only once for a fDWI offence in the 24 months prior to testing. Exclusion criteria: under the influence of alcohol during testing the maximal allowable threshold being BAC of .01 as measured by a Breathalyzer® test.

Measures

The Alcohol Use Disorder Identification Test (AUDIT), Michigan Alcohol Screening Test (MAST), and Timeline Follow back (TLFB) were used to examine symptoms of alcohol misuse, and binge drinking (i.e., 5 or more or 3 or more consumptions in one occasion for males and females respectively). The Millon Clinical Multiaxial Inventory (MCMI) was used to measure symptoms of depression and anxiety, the Stoplight and Balloon Analog Risk Tasks were used to measure impulsive risk-taking, and the UPPS Scale, abbreviated for urgency, perseverance (lack of), premeditation (lack of), and sensation seeking, was used to measure impulsivity and its dimensions. Lack of premeditation (i.e., not planning and acting immediately without reflection) and urgency, (i.e., acting impulsively when experiencing negative affect) have been most related to substance use problems (Verdejo-Garcia, Bechara, Recknor, & Perez-Garcia, 2007).

Procedure

Testing was conducted at the ARP at the Douglas Mental Health University Institute, affiliated with McGill University, in Montreal, Canada. Participants were asked to complete questionnaires and computer tasks to assess alcohol consumption, driving behaviour, impulsivity, symptoms of anxiety and depression and socio-demographic information. Once the self-report questionnaires and computer tasks were completed, participants were debriefed and compensated 50$.

Results

Sample A total of 36 fDWI offenders were recruited. The sample comprised of four groups, younger females (n = 9, mean age = 23.22, SD = 2.22), younger males (n = 12, mean age = 21.67, SD = 2.43), older males (n = 12, mean age = 40.08, SD = 6.31) and older females (n = 3, mean age = 43.67, SD = 2.08). Recruiting female fDWI offenders, especially older females, proved challenging. After one year of concerted recruitment efforts, only 12 female offenders were eligible and willing to participate. Further female recruitment was deemed not feasible for the purposes of this study. Independent samples t-tests assessed the differences between groups on patterns of alcohol consumption, symptoms of anxiety and depression, and impulsivity. An alpha level of .05 was set for inferences for all statistical tests.

Alcohol Consumption Descriptively, younger females experienced more symptoms of alcohol misuse as measured by the AUDIT (M = 15.56, SD = 7.35) than younger males (M = 9.83, SD = 4.82), $t(19) = -2.16$, p = .04. Younger females also engaged in more binge drinking as measured by the TLFB (M = 30.89, SD = 4.85) than both younger males (M = 15.33, SD = 13.55), $t(12.33) = -3.58$, p = .004 and older males (M = 19.25, SD = 17.93), $t(11.96) = 2.56$, p = .025. There were no significant differences for binge drinking between younger and older females. When comparing sex, females engaged in more binge drinking (M = 29.92, SD = 10.22), than males (M = 17.29, SD = 15.67), $t(33.83) = -3.25$, p = .003 (i.e., based upon square-root transformation of TLFB data). Results indicated a trend in the predicted direction where older males scored higher on lifetime alcohol use problems as measured by the MAST (M = 17.33, SD = 10.62) than younger males (M = 10.92, SD = 5.71), $t(22) = -1.58$, p = .12.

Symptoms of psychopathology Older females did not significantly differ on symptoms of depression and anxiety compared to other groups.

Impulsivity Younger females scored significantly higher on the UPPS urgency impulsivity subscale (M = 30.33, SD = 6.10) than younger males (M = 24.75, SD = 5.75), $t(19) = -2.15$, p = .04 and older females (M = 22.33, SD = 2.08), $t(10) = 2.17$, p = .055. A trend in the predicted direction was found with younger males and females scoring higher on UPPS sensation seeking impulsivity subscale (M = 35.90, SD = 6.27) than older males (M = 32, SD = 9.46), $t(34) = 1.5$, p = .14. Younger males specifically did not differ from older males on measures of impulsivity.

Discussion

The goal of the present study was to explore whether underlying risk factors for a fDWI offence are specific to age and sex. This study revealed that sex differences in fDWI were most striking. fDWI offending in younger females was associated with binge drinking, symptoms of alcohol misuse/dependence and with the urgency dimension of impulsivity. Younger female offending appears to be related to greater alcohol misuse, such as binging, possibly to alleviate negative affect. fDWI offending in older males, on the other hand appears to reflect lifetime alcohol misuse as evidenced by their higher scores on the MAST. Younger and older males did not differ on impulsivity suggesting the stability of impulsivity throughout development in these offenders.

Limitations There were fewer female fDWI offenders than male fDWI offenders. Females, especially older females appeared less willing to participate in this study than were males, possibly attributable to greater shame associated with female DWI. As this study's main findings pertain to younger females, exploration of older female offending within fDWI research is imperative. Female offenders might feel embarrassed answering questions in front of researchers at a laboratory and might chose not to participate for this reason. Use of self-report questionnaires mailed to female participants for completion privately could overcome this limitation. Even though this method might not permit the use of behavioural measures, any kind of information pertaining to female fDWI would be important to gain an understanding of this subgroup.

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Examining the stability of transport behaviours for high-risk early adolescents

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Abstract

Background Transport related injury is a leading cause of death and disability for adolescents and represents a substantial burden on public health and the community as a whole. Adolescents appear to have a growing risk of harm due to the co-existence of increasing alcohol use and engagement in risky transport behaviours. Understanding more about the development and stability of these behaviours by young adolescents over time could be beneficial in targeting transport injury prevention interventions for high-risk adolescents. In Australia alcohol use begins to increase significantly through the early and middle adolescent years even though the majority of these young people are still in school.

Aim This paper reports on changes over a six month period in alcohol use, anger management experiences, demographic characteristics and transport risk taking behaviours including riding a bicycle without a helmet and under-age driving for high-risk adolescents and non high-risk early adolescents.

Method Year 9 students (N=1,005) from 20 schools in Queensland, Australia completed a baseline survey in the first half of 2012 and at a six month follow up. Respondents at both times were asked about their engagement in risk taking behaviours measured by Mak's adolescent delinquency scale, which included five transport related items. They were also asked to rate their alcohol use for the preceding three month period. The stability of these risk taking indicators was measured by comparing baseline results with the six month follow up.

Results High-risk adolescents were more likely to report change in their alcohol use and transport behaviours when compared with non high-risk adolescents over a six month period. There were no significant changes in control of anger for either group. Demographic characteristics were not shown to have any significant effect on the stability of risk indicators for high-risk adolescents and non high-risk adolescents.

Discussion and conclusions Differences were found in the stability of risk taking indicators for high-risk adolescents and non high-risk adolescents. The findings of this paper have implications in targeting transport risk behaviour change interventions to meet the needs of high-risk adolescents.

Introduction

Injury continues to be the leading cause of death and disability for young people worldwide, particularly so for transport related injuries (World Health Organisation, 2007). The immediate risk of harm to adolescent health from engaging in risk taking behaviour, including transport risks, is widely acknowledged (Johnson & Jones, 2010; Viner et al., 2012). Longer term adolescent health and social outcomes of risk taking behaviour are further compromised by sustained engagement of such problem behaviours (Larsman et al., 2012). Examining the stability of risk taking indicators over time provides an opportunity to identify associations between common adolescent risk factors that may heighten engagement in risk taking behaviours for high-risk adolescents.

Risky adolescent transport behaviours and associated injury

Transport related injuries are the eighth leading cause of death worldwide and they are the number one cause of death and disability for persons aged 15-29 years globally (WHO, 2013). In Australia, transport related injuries accounted for 35% of all deaths for 15-24 year olds in 2007, and was the leading cause of hospitalisations for persons aged 12-14 years in 2008-2009 (AIHW, 2011). Consequently, adolescent transport related injuries represent a significant physical, social and financial burden.

The rates of transport related injuries increase during adolescence (WHO, 2010). Fifty-three per cent of 13-14 year olds reported at least one transport related injury in a six month period in a study by Chapman and Sheehan (2005). Their findings revealed not only the high prevalence of adolescent transport related injuries, but also that adolescents who reported at least on transport related injury were more likely to report engagement in other risk taking behaviours. A study of different adolescents by the same authors (Buckley, Chapman, Sheehan, 2012) found that adolescents who reported undertaking delinquent behaviours, including risky transport behaviours, were more likely to have reported a medically treated injury. Therefore, indicating an association between adolescent injury experiences and engagement in delinquent behaviour.

Adolescent risk taking indicators

Risk taking indicators, such as alcohol use, are positively related to engagement in risky behaviour and injury experiences during adolescence (Jelalian, Spirito & Rasile, 1997). As such, they are predictors of likely outcomes. Research of adolescents by Jelalian, Alday, Spirito, Rasile & Nobile (2000) found that risk taking indicators including socio-demographics, alcohol use, risk taking and behavioural problems were consistent predictors of transport related injuries. Their research revealed that adolescents who had experienced a transport related injury reported significantly more alcohol use, risk taking, behavioural problems and injuries overall when compared with adolescents who had not experienced a transport related injury in the same six month period.

The aim of this research is to examine the stability of risk taking indicators, including unsafe transport behaviours, for high-risk adolescents over time. The WHO (2007) acknowledges that transport related death and injuries for young people can be significantly reduced by implementing appropriate interventions that are specifically designed to target youth. Identifying how stable risk taking indicators are for transport related behaviours of a high-risk adolescent population reveals their predictive value. Thereby, identifying risk indicators to be targeted in adolescent injury prevention interventions. Whilst research supports that risk taking indicators are reliable predictors of risk taking, less is known about the stability of these indicators over time and for transport related behaviours as they apply to a high-risk adolescent population.

Methods

Participants

One thousand and five Year 9 students (65% female), aged 13-14 years, from 20 high schools (13 State; 5 Independent; 2 Catholic) in South East Queensland and the Rockhampton region of Queensland participated in this study. Identifying information was obtained to allow for matching of participant responses over time. Participants were classified as high-risk during post-hoc analyses if they reported seeking medical treatment for one or more injury in the preceding three month period at baseline.

Measures

All data was obtained from student surveys and included demographic characteristics such as gender, country of birth, ethnic background and adult they reside with most of the time. Mak's adolescent delinquency scale (1987) was used to measure self-reports of engagement in risk taking behaviours, which included five transport related items were included (Ridden with someone who is driving dangerously; Ridden a bicycle on the road without a helmet; Ridden in a car with someone who has been drinking; Driven a car off road; Driven a motorbike off road), as well as self-reports of alcohol use for the preceding three month period.

Participants were also asked to rate self control of their anger for the preceding three month period using the Temper subscale of the Measures of Self-Control (Grasmick, Tittle, Bursik & Arneklev, 1993) which uses a Likert type scale (e.g. I lose my temper pretty easily; Often, when I'm angry at people I feel more like hurting them than talking to them about why I'm angry).

Procedure

Ethical approval to conduct this research was initially obtained from the relevant education board and the university human research ethics committee. Permission was then sought from each Principal of the participating high schools. Consent was provided by parents and participants prior to survey completion.

Participants completed the same survey at baseline (Term 2, 2012) and six months later (Term 4, 2012). The survey was paper based and took approximately 30 minutes to complete. Verbal instructions were provided by a member of the research team.

Statistical Analyses

Initial chi-square tests were conducted to examine differences in demographic characteristics between high-risk adolescents and non high-risk adolescents. Additional chi-square tests were conducted to examine changes in risk taking indicators and alcohol use over six months. An independent samples *t*-test was conducted to compare self management of anger for high-risk adolescents and non high-risk adolescents over six months.

Results

There were significant differences present across high-risk and low-risk adolescent groups for demographic characteristics in the categories of Gender "Male" (64.4% high-risk; 63.5% non high-risk); Ethnic background "White/Caucasian" (77.55% high-risk; 66.54% non high-risk) and "Other" (26.45% high-risk; 33.46% non high-risk), see Table 1. No significant differences existed for any other demographic characteristic, with both groups reflecting similar trends in, birthplace and age.

Table 1

Individual Demographic Characteristics for High-Risk Adolescents and Non High-Risk Adolescents, at Baseline Survey

	High-Risk (n=264)		Non High-Risk (n=652)		χ^2 test
Demographic Characteristic	n	%	n	%	

Ethnic background					$\chi^2(1)4.35$, $p = 0.04$*
White/Caucasian	169	66.54	456	73.55	
Other	85	33.46	164	26.45	
Born in Australia	220	83.97	543	83.28	$\chi^2(1)0.06$, $p = 0.80$
Household composition					$\chi^2(2)2.68$ $p = 0.26$
Lives with both biological parents	187	72.20	501	77.31	
Lives with single parent	37	14.29	74	11.42	
Lives with step parent	28	10.81	57	8.80	
Age at baseline survey					$\chi^2(4)1.16$, $p = 0.88$
13 Years of age	135	52.32	340	52.79	
14 Years of age	115	44.57	289	44.87	
Gender					$\chi^2(1)0.06$, $p = 0.05$*
Female	170	64.40	414	63.50	
Male	94	35.60	238	36.50	

To examine the stability of risk taking indicators for high-risk adolescents and non high-risk adolescents over time, change in behaviour was compared over a six month period, see Table 2. Examination of standardised residuals found that in each category, non high-risk adolescents recorded higher percentages of no change over time when compared with high-risk adolescents. High-risk adolescents were more likely to have significantly changed their alcohol consumption over six months compared with non high-risk adolescents and were less likely to report no change in alcohol consumption over time compared with non high-risk adolescents. The same pattern was found for “Ridden a bicycle on the road without a helmet” and “Ridden with someone who is driving dangerously”. In both categories, high-risk adolescents were significantly more likely to report greater change (increase or decrease in engagement) over time and less likely to report no change over time compared with non high-risk adolescents.

There were no significant differences between high-risk adolescents and non high-risk adolescents for the categories of “Ridden in a car with someone who has been drinking”; “Driven a car off road” or “Driven a motorcycle off road”.

Table 2

Change in Risk Taking Indicators for High-Risk Adolescents and Non High-Risk Adolescents, from Baseline Survey to Six Month Follow Up

	High-Risk		Non High-Risk		χ^2 test
Risk taking indicator	n	%	n	%	
Alcohol use					$\chi^2(2)5.98$, $p = 0.05$*
Increase	9	4.7	13	2.6	
No change	156	81.3	445	88.3	
Decrease	27	14.1	46	9.1	
Ridden bicycle without helmet					$\chi^2(2)6.27$, $p = 0.04$*
Increase	31	16.0	50	9.7	
No change	140	72.2	413	79.9	
Decrease	23	11.9	54	10.4	
Passenger of drink driver					$\chi^2(2)3.20$, $p = 0.20$
Increase	16	8.3	25	4.8	

No change	163	84.5	163	84.5	
Decrease	14	7.3	35	6.8	
Driven car off road					$\chi^2(2)1.77$, $p = 0.41$
Increase	11	5.7	20	3.9	
No change	170	87.6	470	90.9	
Decrease	13	6.7	27	5.2	
Driven motorcycle off road					$\chi^2(2)3.82$, $p = 0.15$
Increase	9	4.7	12	2.3	
No change	175	90.7	489	94.6	
Decrease	9	4.7	16	3.1	
Ridden with dangerous driver					$\chi^2(2)1.31$, $p < 0.00$*
Increase	20	10.3	27	5.2	
No change	151	77.8	455	87.8	
Decrease	23	11.9	36	6.9	

In general, high-risk adolescents reported slightly greater change in the management of their anger (M = 0.08, SE = 0.04) compared with non high-risk adolescents (M = 0.03, SE = 0.02) from baseline survey to six month follow up. However, this difference was not significant $t(69) = -1.01$, $p > .05$.

Discussion and conclusions

High-risk adolescents represent a considerable proportion of the high school population, in this study, almost one third (28.8%) of students aged 13 to 14 years of age in Grade 9. It is therefore important to understand more about the nature of their risk taking behaviour to help target interventions aimed at reducing harm. The findings of this paper contribute to adolescent transport risk literature by identifying differences in the stability of a sample of risk taking indicators for high-risk adolescents and non high-risk adolescents who have not been exposed to an intervention over a six month period. Further, it was found that demographic characteristics were not shown to have any significant effect on the stability of risk taking indicators and there was no significant difference in self management of anger for either group. The dynamic change in risk taking behaviours by high-risk adolescents over time supports the well documented positive relationship between ageing and risk taking in adolescence (Pickett at al., 2002). The findings also suggest that there is more scope to effect change in risk taking behaviour of high-risk adolescents when compared with non high-risk adolescents. As such, the potential to intervene with adolescents who are most at risk of harm is substantial.

Whilst it is recognised that school based intervention programs can be effective in reducing adolescent risk taking behaviours, including transport risk behaviours, less is known about how well school based intervention programs apply to high-risk adolescents in a school environment (Dent, Sussman & Stacy, 2001). The implications of this study have the potential to reduce transport related risk taking behaviours and associated injuries for high-risk adolescents through informing intervention design and implementation specific to the needs of high-risk adolescents. It is suggested that future research examine the stability of risk taking indicators for high-risk adolescents and non high-risk adolescents after participation in a transport risk behaviour intervention so that further inferences can be made about the differences between the two sub-populations. The self-reported nature of the data used is considered a limitation of this study due to the potential for bias or inaccuracy in participant responses. However, research involving self reported transport behaviours for young people by Begg, Langley and Williams (1999) indicated that self reports can be a valid source of risk taking behaviour.

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Profile of fatally injured pedestrians and bicyclists in the United States with high blood alcohol concentrations

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Abstract

Background
In the United States, little research has focused on the problem of alcohol impairment among pedestrians and bicyclists.

Aims
The aim of this study was to investigate the prevalence, trends, and characteristics of alcohol-impaired fatally injured pedestrians and bicyclists.

Methods
The study analyzed 1992-2011 data from the Fatality Analysis Reporting System (FARS), a census of U.S. fatal motor vehicle crashes. Personal characteristics, roadway type, and other factors were examined among fatally injured pedestrians and bicyclists 16 and older who had high blood alcohol concentrations (BACs).

Results
The number of pedestrians killed in motor vehicle crashes decreased and the number of bicyclists killed in motor vehicle crashes increased among ages 16 and older during the study period; however, the percentages with high BACs changed little. Among fatally injured pedestrians, the percentage with BACs ≥0.08% was 39% in 1992 and 37% in 2011. Among fatally injured bicyclists, the percentage with BACs ≥0.08% was 26% in 1992 and 25% in 2011. During the most recent 5 years of data (2007-11), 20,326 pedestrians 16 and older were fatally injured, and 37% of them had BACs ≥0.08%. The percentage of fatally injured pedestrians with BACs ≥0.08% was higher among males (43%) and ages 21-49 (47-50%), on weekends (49%), and in crashes occurring at night, especially during midnight-2:59 a.m. (60%). During the most recent 5 years of data (2007-11), 2,907 bicyclists 16 and older were fatally injured in crashes with motor vehicles, and 26% of them had BACs ≥0.08%. The percentage of bicyclist deaths with BACs ≥0.08% was highest during midnight-2:59 a.m. (49%) and among ages 30-49 (34-36%).

Discussion and conclusions
A substantial proportion of fatally injured pedestrians and bicyclists had high BACs, and this proportion has changed little during the last two decades. To the extent that alcohol impairment of pedestrians and bicyclists contributes to their deaths, countermeasures addressing alcohol consumption among these groups are needed.

Introduction

In 2011, 4,152 pedestrians and 608 bicyclists ages 16 and older in the United States were fatally injured in motor vehicle crashes (Insurance Institute for Highway Safety, 2013). These deaths accounted for 15% of all traffic fatalities for people of these ages. Since 1992, pedestrian crash deaths among ages 16 and older decreased by 12%. During the same time period, fatalities among bicyclists of these ages increased by 45%. There was a general decline in pedestrian fatalities for this age group; deaths reached a low in 2009 and then increased slightly. Bicyclist fatalities experienced more year-to-year variation, increasing most rapidly during 1992-93 and 2003-06, and peaking in 2006.

Alcohol impairment by pedestrians and bicyclists increases their risk of being seriously injured or killed in a crash. A matched case-control study in Maryland found that the risk of being killed or seriously injured in a crash during the daytime was 20 times greater for bicyclists 15 and older with blood alcohol concentrations (BACs) ≥0.08% relative to bicyclists with BACs <0.02% (Li, Baker, Smialek, & Soderstrom, 2001). Pedestrians also are more likely to be killed or injured in a crash with BACs ≥0.10% than with zero BACs (Blomberg, Preusser, Hale, & Ulmer, 1979). Among crash-involved pedestrians and bicyclists, the odds of dying are higher for those who are alcohol impaired compared with those who are not (Kim, Kim, Ulfarsson, & Porrello, 2007; Miles-Doan, 1996).

There are several mechanisms by which drinking can increase a pedestrian's or bicyclist's risk of injury or fatality. Riding a bicycle requires a high level of psychomotor skill, which degrades with increasing BAC (Li et al., 2001). Crash-involved bicyclists who had been drinking are less likely to be wearing helmets than bicyclists who had not been drinking, and thus are more likely to receive head injuries (Crocker, Zad, Milling, & Lawson, 2010). Alcohol impairment also may contribute to decreased cognitive functioning and poor decision-making. In a simulated road-crossing study, adults with BACs of 0.07-0.10% had difficulty integrating speed and distance information when selecting gaps in traffic compared with controls who did not ingest alcohol (Oxley, Lenné, & Corben, 2006). Dultz and colleagues (2011) found that among crash-involved pedestrians who were treated at a trauma center, those who had been drinking were more likely at the time of their crash to have crossed the road at a dangerous location such as at an intersection against the traffic signal, or midblock without a traffic signal, than pedestrians who had not been drinking.

U.S. studies have examined the characteristics of fatally injured pedestrians and bicyclists who were alcohol-impaired. Li & Baker (1994) examined bicyclists killed in crashes during 1987-91 with BACs ≥0.10% and found that those most likely to be alcohol-impaired were male, ages 25-34, and killed in nighttime vs. daytime crashes. In 1992, the per capita death rate for pedestrians with BACs ≥0.10% was highest for those ages 25-34, and the proportion of fatally injured pedestrians with BACs ≥0.10% was larger among males vs. females and among those killed in rural vs. urban crashes (Heermann, Syner, Vegega, & Lindsey, 1994). Shankar (2003) reported that pedestrians killed in single-vehicle crashes in 2001 who were male, ages 30-39, and involved in a nighttime crash had the highest proportions of BACs ≥0.08%; ages 20-29 and 40-49 closely followed.

Because these studies are 10-20 years old, the goal of the current study is to provide an up-to-date description of the prevalence, trends, and characteristics of fatally injured pedestrians and bicyclists with high BACs in the United States.

Methods

The study analyzed 1992-2011 data from the Fatality Analysis Reporting System (FARS), a U.S. census of fatal motor vehicle crashes that occur on public roadways and result in at least one death of a vehicle occupant or nonoccupant within 30 days of the crash. The dataset includes BACs from alcohol tests, as well as imputed BACs when the actual BAC was not reported. Subramanian (2002) describes the methods used for imputing missing values.

Analyses focused on fatally injured pedestrians and bicyclists 16 and older. Trends during 1992-2011 were examined for the percentage of fatally injured pedestrians and bicyclists with high BACs. Using the most recent 5 years of data (2007-11), personal characteristics (age and sex), location of crash (rural vs. urban, roadway type), and time and day of week of crash were examined among fatally injured pedestrians and bicyclists who had high BAC (≥0.08% and ≥0.15%). During 2007-11, actual BACs were reported for 71% of fatally injured pedestrians and 67% of fatally injured bicyclists. Differences in alcohol impairment across various characteristics were similar regardless of whether imputed BACs were included in the analyses; therefore, all the reported findings are based on actual and imputed BACs.

Results

As shown in Figure 1, the percentage of fatally injured pedestrians and bicyclists 16 and older with high BACs changed little from 1992 to 2011. Among pedestrians, the percentage with BACs ≥0.08% was 39% in 1992 and 37% in 2011. Among bicyclists, the percentage with BACs ≥0.08% was 26% in 1992 and 25% in 2011. The percentage of pedestrians and bicyclists with BACs ≥0.15% who were killed in motor vehicle crashes also changed little during the study period.

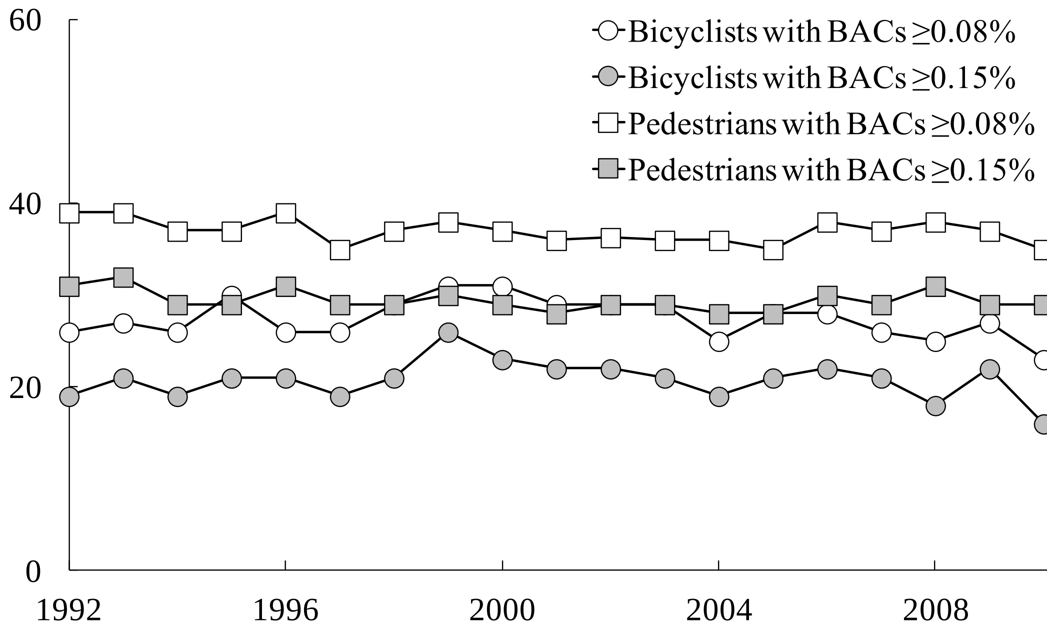

Figure 1. Percentage of fatally injured bicyclists and pedestrians 16 and older with BACs ≥0.08% and BACs ≥0.15%, 1992-2011.

Characteristics of fatally injured alcohol-impaired pedestrians

During 2007-11, 20,326 pedestrians 16 and older were fatally injured, 37% of them with BACs ≥0.08% and 29% with BACs ≥0.15%. As shown in Table 1, the proportion with BACs ≥0.08% was higher among males (43%), ages 21-49 (47-50%), and in crashes occurring on weekends (49%) and at night, especially during midnight-2:59 a.m. (60%). Among fatally injured pedestrians ages 25-34, an age group of interest in previous studies, 50% had BACs ≥0.08%. Patterns for fatally injured pedestrians with BACs ≥0.15% were similar to the patterns for fatally injured pedestrians with BACs ≥0.08%.

Table 1. Fatally injured pedestrians and bicyclists 16 and older with BACs ≥0.08% and BACs ≥0.15%, 2007-11.

	Pedestrians			Bicyclists		
Characteristic	Total deaths	Percent with BAC ≥0.08%	Percent with BAC ≥0.15%	Total deaths	Percent with BAC ≥0.08%	Percent with BAC ≥0.15%
Rural vs. urban						
Rural	5,426	40.1	31.9	839	21.5	16.7
Urban	14,817	35.7	28.6	2,056	27.0	20.0
Roadway type						
Interstates	3,326	37.6	29.8	121	25.5	20.2
Other major roads	11,780	39.4	31.8	1,842	26.8	20.3
Minor roads	5,082	30.4	23.9	924	22.5	16.3
Gender						
Male	14,202	42.6	34.5	2,563	27.0	20.4
Female	6,122	23.5	17.8	344	13.0	8.3
Age (years)						
16-20	1,346	26.3	20.0	227	10.5	7.3
21-29	3,056	49.8	39.1	378	25.1	17.9
30-39	2,811	47.4	38.7	382	34.2	26.0
40-49	3,882	49.8	41.3	670	35.6	28.1
50-59	3,855	43.3	35.3	663	28.6	21.2
60 and older	5,366	12.6	8.7	585	10.3	6.8
Time of crash						
6-8:59 a.m.	1,800	8.9	5.9	346	7.6	3.4
9-11:59 a.m.	1,157	6.0	3.9	327	7.2	5.7
12-2:59 p.m.	1,194	7.6	5.9	347	11.2	7.4
3-5:59 p.m.	1,899	16.9	12.3	447	18.7	13.4
6-8:59 p.m.	4,917	38.7	31.9	588	33.3	26.6
9-11:59 p.m.	4,485	51.9	42.5	456	44.7	35.7
12-2:59 a.m.	2,739	60.3	47.4	220	49.0	35.5
3-5:59 a.m.	2,022	45.2	35.4	170	33.6	22.5
Day of week						
Sunday	2,929	49.3	39.3	353	32.1	22.6
Monday	2,622	30.1	24.2	407	21.3	16.2
Tuesday	2,558	26.1	20.7	391	20.1	15.8
Wednesday	2,720	29.4	23.8	417	21.4	15.4
Thursday	2,668	30.5	24.6	415	21.5	16.7
Friday	3,216	37.5	30.0	477	28.2	21.4
Saturday	3,613	49.0	38.9	447	32.8	24.5

Characteristics of fatally injured alcohol-impaired bicyclists

During 2007-11, 2,907 bicyclists 16 and older were fatally injured. Of these, 25% had BACs ≥0.08% and 19% had BACs ≥0.15%. The percentage of bicyclist deaths with BACs ≥0.08% was highest during midnight-2:59 a.m. (49%) and among ages 30-49 (34-36%). Thirty-one percent of fatally injured bicyclists ages 25-34 had BACs ≥0.08%. Similar patterns were found for fatally injured bicyclists with BACs ≥0.15%.

Discussion and conclusions

Although the number of pedestrian deaths declined and bicyclist deaths increased during the past two decades among people 16 and older, a substantial proportion of fatally injured pedestrians and bicyclists were alcohol-impaired, and this proportion changed little. Based on studies conducted a decade or longer ago, the characteristics of fatally injured pedestrians and bicyclists with high BACs also have changed little. For example, studies consistently have found that fatally injured pedestrians and bicyclists who were alcohol-impaired were more likely to be male and killed in a nighttime crash than those who were not alcohol-impaired.

However, the age groups with the highest rates of alcohol impairment varied somewhat among the studies of fatally injured pedestrians. In crashes in 1992, the rate of BACs ≥0.10% was highest among ages 25-34 (57%) (Heermann et al., 1994). In comparison, the current study of crashes during 2007-11found that the rates of BACs ≥0.08% were elevated for a wider age range, including all age groups for ages 21-49, and Shankar (2003) similarly found the highest rates of BACs ≥0.08% among ages 20-49 in crashes occurring in 2001. Regarding bicyclists killed in crashes, Li & Baker (1994) found the highest rates of alcohol impairment among ages 25-34 during 1987-91, whereas the current study found the highest rates among ages 40-49.

Previous studies have shown that alcohol-impaired pedestrians (Blomberg et al., 1979) and bicyclists (Li et al., 2001) are at higher risk of being killed in a crash than those who are not alcohol-impaired. Further research into the contribution of alcohol in pedestrian and bicyclist crash deaths is needed, including an examination of the profile of alcohol impairment among drivers in crashes involving the deaths of pedestrians and bicyclists. The rate of alcohol impairment is high among drivers as well as pedestrians and bicyclists involved in late-night fatal crashes, for example, and impaired drivers may have contributed to some of the deaths of impaired pedestrians and bicyclists. To the extent that alcohol impairment contributes to pedestrian and bicyclist deaths, the high prevalence of alcohol impairment among fatally injured bicyclists and pedestrians and its persistence over time, suggest that countermeasures should be directed at these groups.

In the United States, few countermeasures have attempted to reduce alcohol-impairment among pedestrians and bicyclists. In Baltimore, Maryland, an education and outreach program was directed at both pedestrians and drivers, with signs telling drivers to watch for pedestrians in areas with large numbers of alcohol-impaired pedestrian crashes and other countermeasures. The program was associated with a reduction in pedestrian fatalities among males ages 30-59 (Blomberg & Cleven, 2000). However, it was not implemented in other cities and was discontinued in Baltimore.

Some programs directed at reducing alcohol-impaired driving would apply to pedestrians and bicyclists as well. For example, responsible beverage service — alcohol sales policies intended to prevent restaurant and bar patrons from driving impaired — might have the potential to reduce pedestrian and bicyclist crashes. Ride service programs that transport drinkers home could also be directed at pedestrians and bicyclists, but the programs typically are limited to certain time periods, such as around holidays.

In summary, the role of alcohol impairment in pedestrian and bicyclist fatalities is substantial in the United States, and despite potentially effective countermeasures, little has been done to address the problem.

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Alcohol Interlocks as instruments for enhanced road safety and prevention of alcohol problems.

Guidelines for authorities, transport companies, transport workers, unions, governments and political decision makers

This document is provided by

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CONTEXT

The Norwegian National Committee, "Alcohol Interlocks for Motor Vehicles" have made a report and a program for the comprehensive use of alcohol interlocks in commercial vehicles with the purpose of winding down the sceptisism and opposition against the use of alcohol interlocks, and prepare a comprehensive guidelines report for the CENELEC committee and EU-commission preparing an EU-directive for alcohol interlocks in commercial vehicles.

The CENELEC Alcohol Interlock Committee was established in 2003. In the past decade, the committee has done a significant job to create universal technical standards and guidelines for the voluntary use of alcohol interlocks.

From being an instrument to control drunk drivers in offender programs (USA, Canada, France, Netherlands and Sweden) the alcohol interlock is now being considered to be an instrument with capability of significantly reducing road fatalities caused by drunk driving. This is a highly sensible political issue, which politicians tends to hesitate entering. The same politicians are also worried by the high toll, and the heavy burden the enormous costs of alcohol related road fatalities draw on the national economies.

The European Parliament issued a resolution of 27 September 2011 on European road safety 2011-2020 (2010/2235(INI) where the EU-parliament:

Recommends that fitting of alcohol interlocks – with a small, scientifically-based range of tolerance for measurement – to all new types of commercial passenger and goods transport vehicles be made compulsory; calls on the Commission to prepare by 2013 a proposal for a Directive for the fitting of alcohol interlocks, including the relevant specifications for its technical implementation.

The Nordic Council 64th session, Helsinki, November 1st 2012:

Recommends the Member Countries to make alcohol interlocks compulsory for commercial and professional drivers in the Nordic Countries, Faeroe Island, Greenland and Aaland.

An EU-directive for alcohol interlocks in commercial vehicles will introduce compulsory general preventive use of alcohol interlocks for a large number of vehicles in all EU and EEA-countries in Europe. Related to equality in competition for transport companies, most of them operating in a cross-border market, there would also have to be introduced standardized laws, regulations, standards, guidelines and definitions in all EU and EEA-countries. Challenges that would have to be overcome in time before the EU-directive will be empowered.

OBJECTIVES.
To find a more comprehensive program of how alcohol interlocks may be used to enhance traffic safety, transport quality, and become a requirement of employment within an alcohol policy of a company or authority, and they may be used for compliance monitoring. The creation of such a model would be prosperous both for reducing road fatalities and for reducing general alcohol problems among people in general.

For the introduction of alcohol interlocks it will be necessary to create credibility for the program by all involved, i.e. the drivers and their unions, transport companies and associates, public authorities and road administration authorities. The main actors involved in the use of alcohol interlocks in commercial vehicles would be:

- Transport customers
- Transport companies
- Transport workers
- International Transport Workers Federations
- Public and political authorities.

The Standards provided by the CENELEC Committee would function best if followed by legislation in the respective countries being influenced by the full-fledged standards. An alcohol interlock is a system comprising a breath alcohol measuring instrument and an immobilizer which may be easily installed in a motor vehicle. Alcohol interlocks that meet the relevant European Standards, should be used in commercial vehicles. The two key standards have been under updating and adjustment, to be published 2013:

Test methods and performance requirements specifically for alcohol interlocks are given in the European Standards EN 50436-1, for offender programs, EN 50436-2 for general preventive use (commercial vehicles and others), and the European Standard EN 50436-6 for data security from the alcohol interlock registry.

Countries have different definitions of when an attempt to drive under influence of alcohol is made. Norway and some others have legislation equalizing attempt to drive with fulfilled DUI. Using an alcohol interlock may, under this type of legislation, be doomed as an attempt to drive, and draw repercussion if the alcohol interlock go into a blocking position.

Definitions of “starting a motor vehicle” may also undergo some scrutiny with compulsory use of alcohol interlock in commercial vehicles. Today it is the starting of the motor (power engine) the alcohol interlock prevents. Transport vehicles may have the motor running during stops, either to provide heating for sensitive wares in cold days, or cooling of frozen wares in warm days. Bussing companies uses piquets to start bus motors in the winter time to provide heating. With alcohol interlocks blocking the motor itself, this may cause unsolvable problems. This may be solved by defining “starting of a motor vehicle” as setting the vehicle “in motion” which means that the alcohol interlock blocks the electronically operated gearbox, brakes or other interlock systems that prevent the vehicle from being moved under its own power without a legal test provided by an alcohol interlock.

Countries have also different limits for DUI, ranging from 0,0 to 0,2 for commercial driving. Using alcohol interlock as compulsory device in commercial vehicles would prompt common legislation for one limit defining DUI for all EU and EEA-countries, and the EU are now providing the ground for a common DUI limit of 0,2 for commercial vehicles for all EU and EEA-countries .

For the introduction of alcohol interlocks it is necessary to create credibility for the program by all involved, i.e. the drivers and their unions, transport companies and associates, public authorities and road administration authorities. To achieve this, the introductory process could be divided into several steps.

Decision and support:
In order to create a sense of commitment and involvement, management decisions based on the EU-directive for alcohol interlock in commercial vehicles, should be communicated at an early stage so that they permeate the entire organization from the decision makers to the actual drivers. This will also include drafts of agreements between the companies and the drivers and/or their unions. As well as standardized set of steps to be taken in case of alcohol interlocks going into locking positions after testing of drivers.

Policy and objectives:
A straightforward policy should be drafted with clear, realistic and quantifiable targets describing the direction and intention for the work ahead. This policy could be associated with legal issues and health and safety campaigns. The policy should be communicated repeatedly in order to be made known within the entire organization if it is to gain acceptance and stimulate a sense of involvement. The aim of this policy will both be to benefit the company standing, and the safeguarding of the employed drivers of the company.

Action plan and measures:
The action plan describes how the policy is to be put into effect, e.g. time schedules, allocation of responsibilities, etc. It should also take into consideration the individual employee's sense of integrity and job security. The measures undertaken through the plan could for example involve information campaigns, training and instruction programs in connection with the introduction of alcohol interlocks, or stipulating the use of alcohol interlocks in future transport procurements.

Monitoring and evaluation:
Monitoring and evaluation is a necessary part of a systematic work method to show whether the objectives of the policy have been achieved. This could be done for example by monitoring of:

- the data memory of the alcohol interlocks,
- manipulation attempts,
- false positive tests,
- regular calibration of the alcohol interlocks,
- traffic and work accidents,
- illness times of employees.

The data from the alcohol interlock registry are highly sensitive, and the handling will be under scrutiny of the countries Data Supervision Authorities. The companies would therefore have to have a coherent and comprehensive system to handle the data, as well as the follow up the results.

KEY OUTCOMES

For the introduction of alcohol interlocks it will be necessary to create credibility for the program by all involved, i.e. the drivers and their unions, transport companies and associates, public authorities and road administration authorities. In order to create a sense of commitment and involvement, management decisions for alcohol interlock in commercial vehicles, should be communicated at an early stage so that they permeate the entire organization from the decision makers to the actual drivers. This will also include drafts of agreements between the companies and the drivers and/or their unions. As well as standardized set of steps to be taken in case of alcohol interlocks going into locking positions after testing of drivers. A straightforward policy should be drafted with clear, realistic and quantifiable targets describing the direction and intention for the work ahead.

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Dialogue with union representatives and other relevant bodies

An alcohol interlock could be considered as an intrusion in the personal environment. The obligation to inform and negotiate with the union when installing an alcohol interlock could vary from country to country depending on national laws and the contract between the employer and the employee.

Regardless of the rights the employers have to install the alcohol interlocks, it is valuable to have a dialogue with the workers and their unions in beforehand. The use of alcohol interlocks will also have impact on the employee’s health and safety, which gives an opportunity of mutual understanding between the employer and the employee. The experiences from Norwegian Companies implementing alcohol interlocks shows that the alcohol interlock is rather quickly accepted as long as the management has had a proper dialogue with the employees before installing the alcohol interlocks

It should be a policy for each workplace preventing alcohol damage inclusive information and education campaigns, and to offer the employees with alcohol related troubles help and specialist care. Another area is to reduce the number of casualties and death in relation with traffic accidents.

For a transport company an alcohol and drug policy has three important purposes. It should:

- Contribute to quality assurance to customers and commissioners.
- Contribute to increased traffic safety
- Show concern about the companies employees.

Usually an alcohol abuse is covered a long time by the employee. When the problem reveals it is often hard and expensive to deal with. And there is a big risk of accidents due to the alcohol problems of the employee. Alcohol interlocks installed in all of the companies vehicles could detect alcohol problems at an early phase to be confronted and solved, and thus enhance the alcohol and drug policy of the company.

The AKAN-model in Norway.
AKAN, The workplace advisory center for issues relating to alcohol, drugs and addictive gambling, was founded in 1963 by representatives from the Norwegian Confederation of Trade Unions [LO] and the Confederation of Norwegian Business and Industry [NHO].

AKAN's main objective is to contribute to:

- Prevent alcohol and drug problems in Norwegian enterprises.
- Develop methods for early intervention and enable employers and employees to take action.
- Provide help and assistance for employees already having developed a substance problem.

Through its work and activities, AKAN aims at qualifying employees and employers for constructive collaboration when encountering the challenges of alcohol and drug problems in the workplace.

Based on the data and records from the AKAN model in use in Norwegian Companies, related to alcohol and drug abuse in the workplace, 80% of employees with emerging alcohol problems, being incorporated in the AKAN model for prevention of alcohol and drug problems, are in full working condition within one year after their entry into this agreement.

DISCUSSIONS AND CONCLUSIONS
Regardless of the rights the employers have to install the alcohol interlocks, it is valuable to have a dialogue with the workers and their unions in beforehand. The use of alcohol interlocks will also have impact on the employee's health and safety, which gives an opportunity of mutual understanding between the employer and the employee. The experiences from Norwegian Companies implementing alcohol interlocks shows that the alcohol interlock is rather quickly accepted as long as the management has had a proper dialogue with the employees before installing the alcohol interlocks. For more than 40 years, in Norway the AKAN model, a joint venture between the Norwegian Confederation of Trade Unions [LO], the Confederation of Norwegian Business and Industry [NHO]and the Government, has contributed to the prevention and solving of alcohol and drug problems in Norwegian enterprises. The Norwegian National Committee "Alcohol Interlocks for Motor Vehicles" have adjusted the AKAN-model for use together with alcohol interlocks in commercial vehicles. For enhanced traffic safety and public health care.

Installing an alcohol interlock as a general preventive measure in vehicles for the safe transport of persons or goods such as hazardous goods transporters, trucks, lorries, coaches, taxis, trains, boats, snow mobiles or other modes of transportation can reduce accidents and related downtime. Alcohol interlocks may be used as a transport quality instrument for vehicles operated by companies or authorities. They may also be a requirement of employment within an alcohol policy of a company or authority, and they may be used for compliance monitoring.

The alcohol interlock in commercial vehicles may become an instrument of high value also in the prevention of people being exposed to the threat of falling into problems with alcohol and drugs. Thus, the use of alcohol interlock in commercial vehicles, combined with companies introducing programs of prevention and cure, not only enhances traffic safety by preventing drunk driving, but also may be key instrument in prevention of development of alcohol and drug problems in general.

Prevention and cure of emerging alcohol problems is far less resource consuming than a full scale alcohol problems resting with the employee. Related to the public health perspective, the use of alcohol interlocks may also save the society and the tax payers for significant amount of resources, today yearly spent on curing and reparation of alcohol related damages every year. With the aid of alcohol interlocks, the employee may have the option of receiving adequate support and help at an early stage before the alcohol problems have passed by the point of no return.

Any employee taken care of by this system, may also agree to follow the prevention and cure program. Based on the data and records from the AKAN model in use in Norwegian Companies, related to alcohol and drug abuse in the workplace, 80% of employees with emerging alcohol problems, being incorporated in the AKAN model for prevention of alcohol and drug problems, are in full working condition within one year after their entry into this agreement. The key here is the agreement between the companies, the unions, and the authorities to arrange for prevention and cure of emerging alcohol problems.

With the compulsory use of alcohol interlocks as presented in a coming EU-directive for commercial vehicles, companies and organizations are able to ensure customers, users and public opinion that their vehicles are being driven by sober drivers. Alcohol interlocks may then also be an element of companies alcohol and overall quality assurance policy. Such a wholastic approach requires determination and patience and has to be integrated step by step into normal operations.

Companies and organizations that procure or provide transportation will help to improve road safety through the use of alcohol interlocks to counteract drink driving. They will also bolster the customers view of the company, create a better working environment, and achieve competitive advantages for their own operations.

From being a punitive instrument for DUI, the alcohol interlock has moved into an area of general prevention use in commercial vehicles to enhance safety of deliverance of goods and wares. The alcohol interlock also is about to become an instrument of assurance of quality transport of persons in busses and taxis. The alcohol interlock may also enter into the field of public health precautions, as it may be utilized to reduce the burden of alcohol problems within transport companies, commercial drivers, and all other who will use a motor vehicle as part of their jobs. Expanded use of alcohol interlocks may benefit the employers, the employees and also the societies, as it may reduce the fear of being encountered by drunk drivers.

The extended use of alcohol interlocks may fulfill the Act of Human Rights in Traffic, by offering Freedom From Traffic-drugs.

This achievement will depend of the will and ability to make the right political decisions.

Alcohol and other drug involvement in fatally injured drivers in the United States

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Abstract

Since 1982, the United States has been tracking the blood alcohol concentrations (BACs) of drivers fatally injured in traffic crashes. Since 1998, some U.S. states have been tracking drugs other than alcohol in fatally injured drivers. Using the U.S. Fatality Analysis Reporting System (FARS), we (a) examined the trends from 1982 to 2011 for BACs in fatally injured drivers and (b) examined the use of other drugs in fatally injured drivers in recent years. In 2010, 71% of driver fatalities were tested for BAC. For other drugs, only states with a known lab result for at least 80% of fatally injured drivers who died at the scene were included in our analyses (nine states). When BAC data are unavailable, it is statistically imputed using crash characteristics to obtain more complete and accurate alcohol data. In 2011, 33% of fatally injured drivers had impairing BACs (≥.05 grams per decilitre [g/dL]); 31% were at or above the illegal BAC limit in the United States (BAC ≥.08g/dL); and 23% had very high BACs (≥.15g/dL). These percentages are a vast improvement over 1982 when the percentages were, respectively, 52% (≥.05g/dL), 49% (≥.08g/dL), and 35% (≥.15g/dL). Fatally injured drivers in single-vehicle crashes who died at the scene in the nine high-testing states between 2000 and 2010 indicated that 27% tested positive for drugs other than alcohol (recreational, medicine, etc.), with 8% having cannabinoids and 7% having stimulants in their systems at the time of the fatal crash. Reasons for the decline in alcohol-impaired driving between 1982 and 1997 are described. Resuming progress in reducing impaired driving may require lowering the illegal BAC limit for driving and increasing the focus on drugs other than alcohol.

Background

Motor-vehicle crashes are the leading cause of death for Americans age 4 and ages 11 through 27 (Subramanian, 2012). In the United States, alcohol-impaired driving was involved in 31% of fatal crashes in 2010 and resulted in more than 10,000 deaths (National Center for Statistics and Analysis, 2012). Alcohol-related crashes cost the U.S. society an estimated $129 billion in 2006 (Zaloshnja & Miller, 2009). A national roadside survey (NRS) of nighttime weekend drivers in 2007 indicated that 2% of the drivers on the roads had illegal BACs (Lacey et al., 2009b). Zador, Krawchuk, and Moore (2000) estimated that only 1 of 88 drivers with illegal BACs is arrested for driving while intoxicated (DWI). A national telephone survey of more than 10,000 drivers showed that U.S. drivers admitted to 85.5 million drinking-driving trips in the past 30 days during 2008 (Moulton, Peterson, Haddix, & Drew, 2010). Although impaired driving was reduced in the United States between 1982 and 1997, little has been achieved since that time (Dang, 2008; Fell, Tippetts, & Voas, 2009). In recent years, 1.4 to 1.5 million drivers are arrested annually for DWI (FBI, 2012), which was more arrests than for larceny or theft, assaults, weapons charges, or vandalism, as examples. About the same number of people is arrested each year for drug abuse violations as for DWI.

Aims

The aims of this study were (a) to examine trends from 1982 to 2011 based on the presence of BAC in fatally injured drivers in the United States and (b) to examine the prevalence of other drugs in fatally injured drivers in recent years.

Methods

Alcohol

The FARS is a census of all fatal crashes (defined as a death of a participant within 30 days of the crash event) occurring on U.S. public roadways and reported to the police. FARS analysts are stationed in each of the 50 states, the District of Columbia, and Puerto Rico. They collect data in more than 100 categories from several state data sources (including state crash report records, driver records, death certificates, vehicle registration files, and other sources), which they enter into a local computer database. Alcohol involvement is documented through BAC test results collected by police or coroners. When such data are unavailable, the BACs of drivers, pedestrians, and cyclists are statistically imputed using crash characteristics (such as a police report of driver impairment) to obtain more complete and accurate alcohol data (Subramanian, 2002). This imputation is available in FARS for each year from 1982 through the current year. It provides a BAC value for every driver, pedalcyclist, and pedestrian in the FARS file.

Other drugs

Drug information in FARS has improved in recent years. About 16 states have provided drug-testing results for at least 80% of their fatally injured drivers for the past 10 years. For this part of the study, we used the 2000-2010 FARS. We limited our sample to fatally injured drivers (surviving drivers are rarely tested for drugs) who died at the scene (to avoid confounding our results by the provision of medications to the drivers by caregivers after the crash), and from states with a known lab result for at least 80% of the drivers. We further limited our sample to nine states with a sample of at least 300 drivers in each year (to allow for meaningful trend estimates). To ensure proper identification of crash responsibility, we also excluded drivers who (a) presented a condition signalling them as mentally challenged; (b) were involved in a police chase; (c) were driving buses, snowmobiles, construction or farm equipment; or (d) were parked or in the process of parking a vehicle.

Results

Alcohol

Between 1982 and 1997, the proportion of fatally injured drivers with impairing levels of alcohol (BACs ≥.05 g/dL) decreased from 52 to 34% (a 35% reduction in that proportion) but then levelled off at 33-36% up through 2011 (Figure 1).

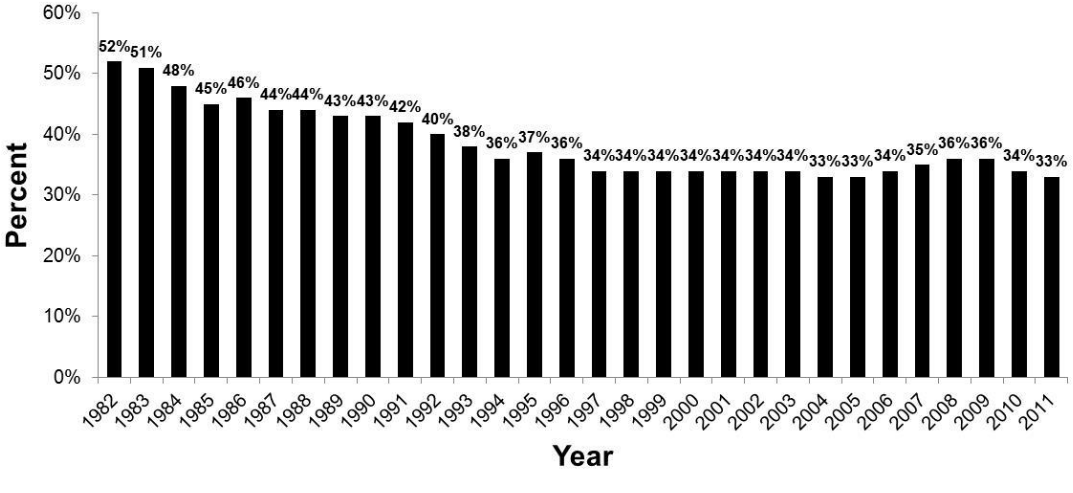

Fig 1. Proportion of fatally injured drivers impaired by alcohol (BAC ≥.05), 1982-2011, [-35%]

The percentage of fatally injured drivers who were intoxicated (BACs ≥.08 g/dL) went from 49% in 1982 to 32% in 1997 (a 35% reduction) and then levelled off at 31-33% up through 2011 (Figure 2).

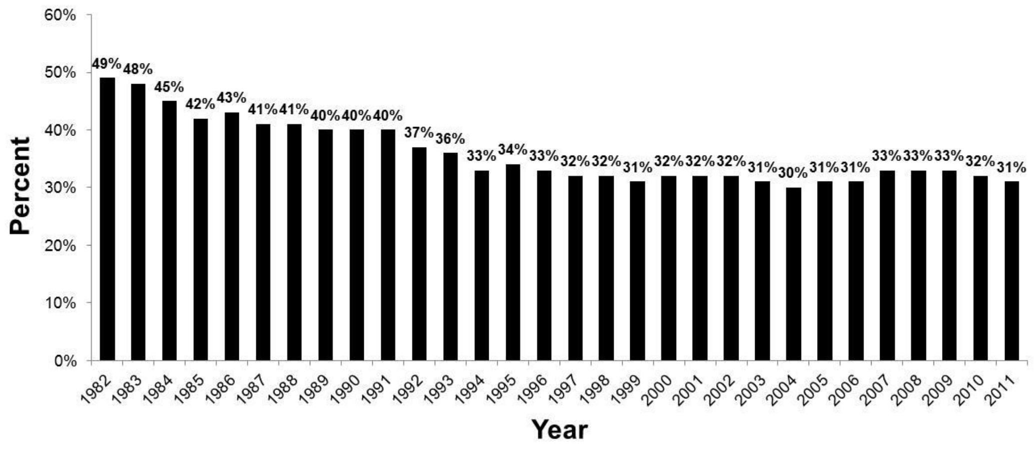

Fig 2. Proportion of all fatally injured drivers estimated to have been legally intoxicated (BAC≥.08), 1982-2011, [-35%]

The percentage of fatally injured drivers with very high BACs (≥.15 g/dL) was reduced from 35% in 1982 to 23% in 1997 (a 34% reduction) and then remained at 22-24% through 2011 (Figure 3).

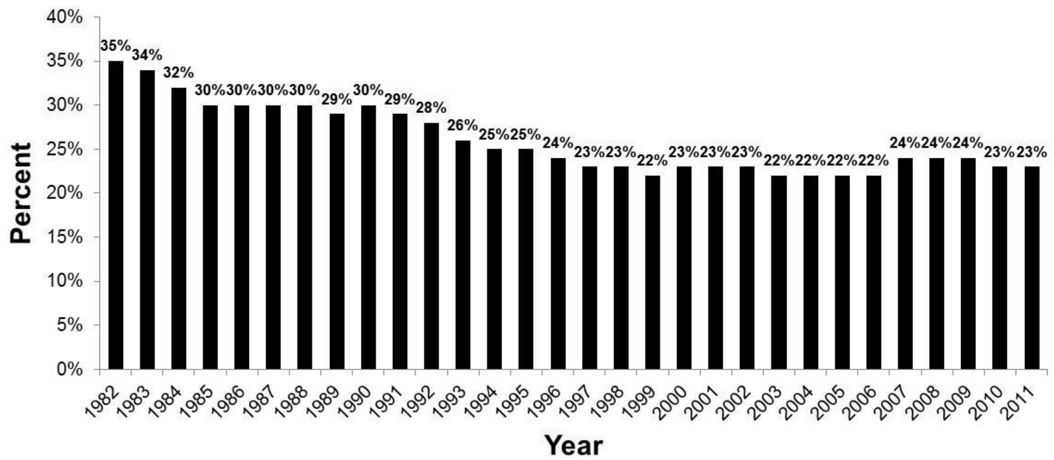

Fig 3. Proportion of fatally injured drivers with very high BACs ≥.15, 1982-2011, [-34%]

Other drugs

Overall, from 2000 to 2010, 45% of fatally injured drivers tested positive for alcohol (with 40% at BACs ≥.08 g/dL) and 27% for other drugs. The most common drugs present were stimulants (7%) and cannabinols (marijuana) (8%), followed by other drugs (4%), multiple drugs (4%), narcotics (2%), and depressants (2%) (Figure 4). The prevalence of cannabinols among the fatally injured drivers has increased from about 4% in 2000 to 11% in 2010.

Alcohol and other drugs

The association between drug and alcohol use is positive, particularly between marijuana and high BAC drivers. We found that almost 60% of all drivers positive for marijuana had a BAC ≥.08 g/dL, and among those fatally injured drivers positive for stimulants, 42% had BACs ≥.08 g/dL.

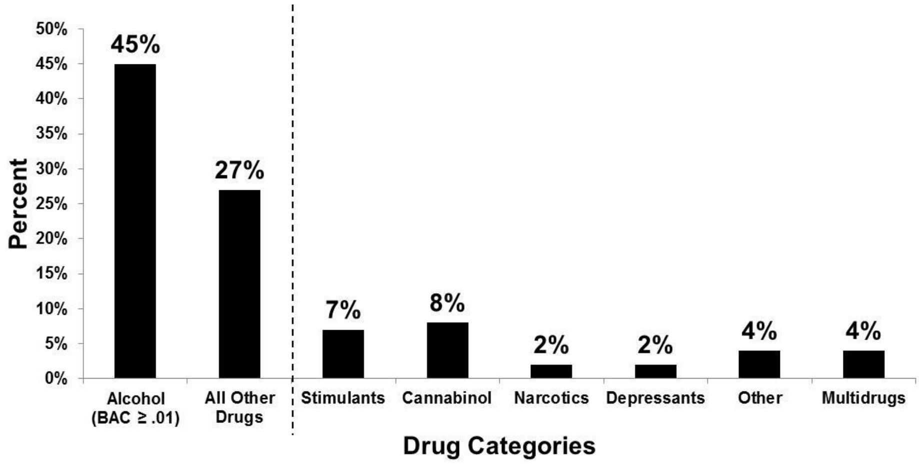

Fig 4. Drug prevalence in fatally injured drivers in single-vehicle crashes/driver died at scene FARS 2000-2010, nine states with ≥80% testing for drugs

Discussion

The United States enjoyed a remarkable downward trend in crashes related to alcohol-impaired driving between 1982 and 1997, which has since levelled off. That trend coincided with a period during which per capita alcohol consumption declined and the number of young drivers decreased, but those factors alone did not appear to account for the overall reduction. Thus, safety program activity may have been responsible for at least some of the decline. Previous studies have shown that certain laws (e.g., lowering the per se limit to .08; administrative license revocation [ALR]) and enforcement programs (e.g., high-visibility checkpoints) can significantly reduce the number of alcohol-involved drivers in fatal crashes by effect sizes in the 7 to 10% range per intervention (Shults et al., 2001). Further, lowering of the per se BAC limit (e.g., .08 to .05 g/dL), coupled with increased enforcement efforts, might feasibly save as many as 1,700 to 3,400 more lives per year (Transportation Research Board [TRB], 2010).

In the analysis of other drugs, we found the prevalence of alcohol-positive drivers (45%) was significantly higher than for drug-positive drivers (27%). Drug prevalence in our sample also was substantially higher than among the drivers in the 2007 NRS: 11.2% with drugs in the daytime and 14.4% at night (Lacey et al., 2009a). Prior analyses show that alcohol and drugs contribute differently to crash risk and may also indicate that the mechanisms and patterns for which alcohol and drugs contribute to crash risk are different. Recently, Romano and Pollini (2013, in press) supported this conclusion by reporting that drug-impaired driving differs from alcohol-impaired driving, as the hourly patterns of crash-related fatalities involving drugs differed significantly from those involving alcohol. These and related findings by Romano and Voas (2011) that individual drug classes are associated with various traffic violations (e.g., red-light running, speeding) in fatal crashes suggest that criteria for developing effective laws and enforcement strategies to reduce driving under the influence of drugs (DUID) may need to be significantly different than those currently applied to alcohol.

Finally, our trend analysis revealed that the prevalence of marijuana among fatally injured drivers is steadily increasing. Interestingly, this trend for marijuana reverses the one for alcohol, whose prevalence among fatally injured drivers has been stalled for at least 15 years. Despite findings showing the contribution of marijuana and other drugs in drivers killed in crashes is smaller than that of alcohol, the continuous increase in marijuana use among fatally injured drivers calls for continuous monitoring of the relative contribution of drugs and alcohol to fatal crashes. These findings contribute to a growing body of literature suggesting that concerns about DUID should complement, not supplant, the current law enforcement focus on alcohol-impaired driving at night.

Conclusion

The United States has fallen behind several nations in its progress to reduce impaired driving (TRB, 2010). Notably, Australia and Sweden have substantially lower percentages of fatally injured drivers at impairing levels of BAC (Figure 5). Tougher laws (e.g., lowering the BAC from .08 to .05 g/dL) could potentially save thousands of U.S. lives (Fell & Voas, 2009; Wagenaar, Maldonado-Molina, Ma, Tobler, & Komro, 2007). The rationale for lowering the BAC limit to .05 is compelling: (a) the risk of a crash and driving performance decrements are significant at .05; (b) most U.S. drivers do not think one should drive after 2 to 3 drinks (a BAC of .05 for most people); (c) studies from Australia and Europe indicate a reduction in impaired-driving crashes after lowering their limit from .08 to .05 BAC; and (d) most nations have adopted .05 BAC (63 have .05 vs. 21 with .08) and many U.S. and world public health organizations endorse the .05 BAC limit.

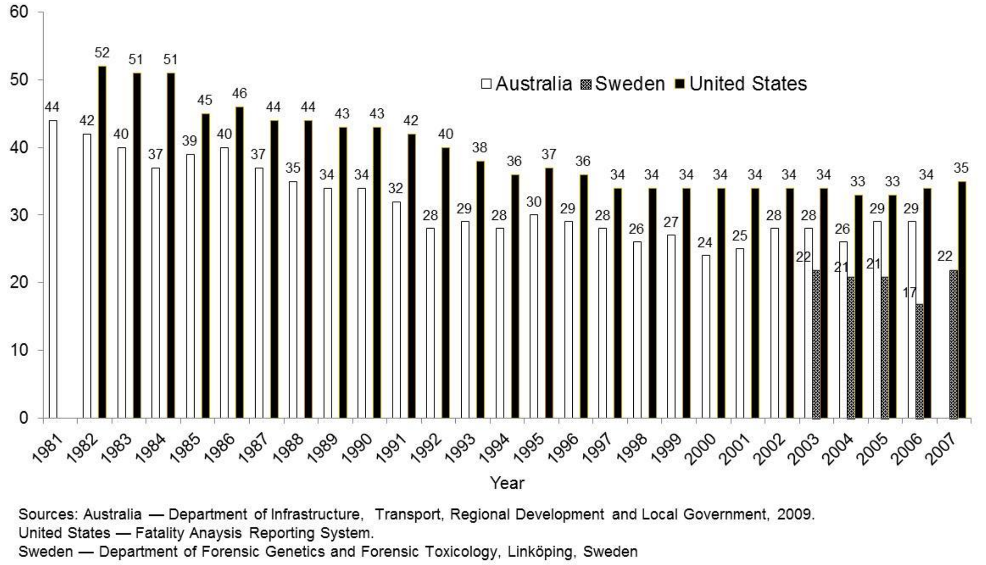

Fig 5. Percentage of fatally injured drivers with a BAC of .05 or more in Australia, Sweden, and the United States

Our findings may also provide a foundation for exploring targeted drug testing of impaired drivers. For example, a daytime female driver older than 65 who appears impaired but records a BAC<.08 might be tested for narcotics, which is more likely to yield a positive result than cannabinols. Narrowing down the tests required to identify the drug causing driver impairment could be valuable to law enforcement agencies operating on limited budgets. However, our study only justifies targeted testing as an area for further study as our data were limited to fatally injured drivers who died at the scene of single-vehicle crashes in nine states and not the entire U.S. driving population. More research on the key components of the DUID problem is needed before targeted drug testing can become a feasible policy. Of primary importance is characterizing the actual contribution of drugs to impairment and crashes, both alone and combined with alcohol.

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A national evaluation of graduated driver licensing laws in the United States

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Abstract

Graduated driver licensing (GDL) laws now exist in all 50 states and the District of Columbia in the United States. These GDL systems are designed to reduce the exposure of young novice drivers to risky situations (such as late-night driving and driving with other teen passengers when alcohol is likely to be involved). Our aims were to determine if (a) GDL laws reduce fatal crash involvements of novice drivers; (b) nighttime and passenger restrictions are effective components, especially in reducing fatal crashes involving young drinking drivers; and (b) there are differential effects of GDL laws based upon driver race and ethnicity. A longitudinal panel study and logistic regression analyses were used to meet the aims. The 1990-2007 Fatality Analysis Reporting System (FARS) data sets were used to determine if changes in crash involvements of young drivers and young drinking drivers were associated with the adoption of GDL laws. GDL laws with stricter components showed stronger relationships to fatal crash reductions (from 8 to 13%), and laws with weak components showed no reductions in crash involvements. Nighttime restrictions were found to reduce 16- and 17-year-old driver involvements in nighttime fatal crashes by an estimated 10% and 16- and 17-year-old drinking drivers in nighttime fatal crashes by 13%. Passenger restrictions were found to reduce novice driver involvements in fatal crashes with teen passengers by an estimated 9%. GDL reductions were largest for young White drivers, followed by African-Americans, and then Asians, with no significant reductions for young Hispanics. States without the nighttime or passenger restrictions in their GDL laws should strongly consider adopting them. The differential effects of GDL laws based on the race and ethnicity of young drivers needs further research.

Background

Motor-vehicle crashes are the leading cause of death for young people aged 15 to 20 in the United States, accounting for approximately 36% of their deaths. Young drivers aged 15 to 20 make up 8 to 9% of the U.S. population but only about 6 to 7% of the licensed drivers; however, they are involved in 11 to 14% of the fatal traffic crashes in recent years. About 22 to 24% of young drivers (aged 15 to 20) involved in fatal crashes are estimated to have been drinking before their crash. The crash rates of 16-year-old drivers are three times greater than 17-year-olds, five times greater than 18-year-olds, and twice those of drivers aged 85.

To address the young driver problem, traffic safety officials from several organizations in the United States developed a licensing system that prolongs the learning process for beginning drivers and restricts their driving to less risky conditions. Typically, GDL programs require three stages: a supervised learning stage of 6 months or more, an intermediate or provisional license stage of several months with restrictions on high-risk driving, and finally, full license privileges with no restrictions. This three-staged national model for GDL has been established so that beginning drivers must demonstrate responsible driving behavior (no traffic offenses) in each stage before advancing to the next stage. After novice drivers have graduated from supervised driving to independent driving, most GDL systems restrict nighttime driving and the number of teen passengers, among other provisions, until the novice driver is fully licensed.

GDL laws now exist in all 50 states and the District of Columbia. These laws generally require three-staged licensing for novice drivers: (a) a learner's permit period—practice driving with a licensed driver aged 21 or older; (b) an intermediate or provisional stage—drive solo only under certain conditions (e.g., restricts late-night driving and limits teen passengers); and (3) a full license with no restrictions (minimum age of 18 in some states). The young driver must meet certain requirements to "graduate" to each stage. Studies of GDL systems in the states have indicated they help reduce the crash rates of young drivers. Table 1 summarizes some of the national studies.

Table 1. Summary of graduated driver licensing national evaluation studies

Authors/Year	Jurisdiction	Characteristics of driver population	Findings	Measures Used	Comparison Group Used
Baker, Chen, Li (2006) NHTSA Report	43 states	16-year-old drivers	11% reduction in Incidence Rate Ratio of 16-year old drivers in FARS	Incidence Rate Ratios of drivers in FARS	20- to 24-year-olds and 25- to 29-year-olds
Baker, Chen, Li (2007) AAAFTS Report	43 states	16-year-old drivers	38% reduction in fatal crashes and 40% reduction in injury crashes for 16-year-old drivers in states with 5 of 7 GDL components; 11 to 19% effect for weak GDL states	Incidence Rate Ratios of drivers in FARS and in injury crashes from State Crash Files	20- to 24-year olds 25- to 29-year-olds 30-54 year olds
Chen, Baker, Li (2006) *Pediatrics*	43 states	16-year-old drivers	18 to 21% reductions in 16-year-old driver involvements in FARS in states with ≥5 of 7 components.	Incidence Rate Ratios of drivers in FARS	20- to 24-year-olds and 25- to 29-year-olds
Dee, Grabowski, Morrisey (2005) *J Health Economics*	48 states	15- to 17-year-old drivers	5.6% reduction in traffic fatalities for 15-to 17-year-olds in FARS. 19% reduction in states with "good" GDL	Differences-in-Differences; Differences-in-differences-in-differences	States without GDL laws (DD); 21- to 23-year-olds and 24- to 26-year-olds (DDD)
McCartt, Teoh, Fields, Braitman, Hellinga (2009) IIHS Publication	50 states	15- to 20-year-old drivers	30% lower fatal crash rate for 15- to 17-year-olds in FARS in "Good" GDL States; 11% lower in "fair" GDL states	Fatal Crash Rates per 100,000 population	30- to 59-year-old drivers
Vanlaar, Mayhew, Marcoux, Wets, Brijs, Shope (Vanlaar et al., 2009) TIRF publication	46 states & DC 11 Canadian provinces	16- to 19-year-old drivers	19% reduction in Relative Fatality Risk of 16-year-old drivers in GDL jurisdictions. No effect on 17- to 19-year-olds	Meta-Regression Analysis of Relative Fatality Risk of drivers	25- to 54-year-old drivers

Our aims required three separate studies (a) to determine the overall effectiveness of GDL laws on reducing young novice driver fatal crashes; (b) to evaluate the effectiveness of two key components of GDL laws—the nighttime and passenger restrictions; and (c) to determine if there have been differential effects of GDL laws on young drivers according to their race and ethnicity.

Methods

A longitudinal panel approach (sometimes called a "cross-sectional time-series approach") was used in our first study. We examined annual FARS data for all 50 states and the District of Columbia

(DC) from 1990 through 2007. We combined the state-by-year crash incidences of 16- and 17-year-olds because many state-by-year cells had an incidence rate of zero when these ages were observed separately. DC was excluded due to reporting zero crashes among 16- and 17-year-old drivers in more than half of the years observed after the ages were combined. We applied a Box and Jenkins (1976) ARIMA (Autoregressive Integrated Moving Average) intervention regression method to evaluate the enactment of a GDL law (the intervention) on the fatal crash incidence among 16- and 17-year-old drivers relative to the two older driver age groups.

To account for crash exposure, we computed and compared ratios of the drivers aged 16-17 involved in fatal crashes with two older age groups: 19-20 and 21-25. We used the crash population aged 19-20 and 21-25 as proxy denominators for drivers aged 16-17 to control for most of the driving exposure elements common to both groups. The Insurance Institute for Highway Safety (IIHS) rated a GDL law as "good" if it had five or more of the following seven components: (a) minimum age for a learner's permit, (b) mandatory waiting period before applying for intermediate license, (c) minimum hours of supervised driving, (d) minimum age for intermediate license, (e) nighttime restriction, (f) passenger limitation, and (g) minimum age for full licensing. Regression models for each age-group ratio were separately performed for the three categories of GDL laws (average, good, and less than good). The ratios of interest (drivers aged 16-17 involved in fatal crashes relative to the two other age groups) were then regressed on the GDL laws alone and with each of the four potentially confounding laws and, finally, with all four covariates included in the analysis.

For our second study of the effects of nighttime and passenger restrictions, counts of drivers aged 16-17, 19-20, 19-25, and 19-29 in nighttime (9 p.m. to 5 a.m.) fatal crashes, and counts of drivers aged 16-17 in daytime (5 a.m. to 9 p.m.) fatal crashes were aggregated into a state-by-year data structure in which repeated yearly counts of crashes were nested within states. Parallel age group-specific count aggregates were computed for (a) fatal crashes with passengers present and (b) fatal crashes with drivers aged 16-17 with no passengers, collapsing across the daytime and nighttime periods previously defined. For models examining effects of nighttime driving restrictions on nighttime fatal crashes among drivers aged 16-17, we computed ratios of nighttime fatal crash counts for drivers aged 16-17 (the numerator) versus nighttime fatal crashes for each of the other three comparison age groups (the denominators), and we computed a ratio of nighttime fatal crashes for drivers age 16-17 versus daytime fatal crashes for drivers aged 16-17, resulting in four outcome measures. To examine effects of nighttime restrictions on alcohol-involved fatal crashes among drivers aged 16-17 (those with BACs>.01 g/dL), we computed an additional set of parallel ratio measures: alcohol-involved fatal crashes for 16- and 17-year-old drivers versus alcohol-involved crashes for each of the three groups of older drivers and alcohol-involved fatal crashes for drivers aged 16-17 versus non-alcohol-involved crashes for drivers aged 16-17 (those with BACs=.00 g/dL). To examine effects of passenger restrictions, another set of parallel ratio measures was computed: that is, three age group comparison ratios plus one passenger present versus no passengers present ratio for drivers aged 16-17 only. The use of ratios (e.g., nighttime fatal crashes vs. daytime fatal crashes) as dependent measures largely controls for state- and year-specific driving and safety conditions, reducing the need for covariates that predict fatal crashes. Using ratios also controls for differences in jurisdiction (state) size. To examine the effects of GDL restrictions on driving at night and driving with teenage passengers, we estimated a series of random intercept mixed models in which we treated annual measurements of crashes as repeated observations nested within states (18 years per state x 50 states = 900 state-year observations).

In our third study of GDL effects by race and ethnicity, three logistic regressions were performed, each modeling the likelihood that the driver in the crash would have a BAC>.00, a BAC≥.08, or would have been speeding, respectively. For each of these models, the effect of the adoption of the GDL law in that state on the specific crash type by race/ethnicity using White drivers as the reference was examined. Also included was a time variable (year) to account for trends and dual interactions were conducted between race/ethnicity, age, and the adoption of the GDL law. Analyses of these interactions are considered highly relevant to this study as they were used to test whether the adoption of the GDL law would have a larger effect on drivers aged 15 to 17 than on drivers of other age groups (our hypothesis). Analyses were also conducted to determine whether the GDL law had a proportionally different effect on racial/ethnic groups other than Whites.

Results

We found that the adoption of a GDL law of average strength was associated with a significant decrease in fatal crash involvements of drivers aged 16-17 relative to fatal crash involvements of older drivers. GDL laws rated as "good" by the IIHS (www.iihs.org) showed stronger relationships to fatal crash reductions (about 8 to 13%), and laws rated as "less than good" showed no reductions in crash involvements relative to the older driver comparison groups. States that adopt a basic GDL law can expect a decrease of 7 to 11% in the proportion of drivers aged 16-17 involved in fatal crashes (relative to drivers aged 21-25), depending upon other existing laws that affect novice drivers (Fell, Jones, Romano, & Voas, 2011b).

Nighttime restrictions were found to reduce involvement of drivers aged 16-17 in nighttime fatal crashes by an estimated 10% and *drinking* drivers aged 16-17 in nighttime fatal crashes by 13%. Passenger restrictions were found to reduce involvement of drivers aged 16-17 in fatal crashes with teen passengers by an estimated 9%. These results confirm the effectiveness of these provisions in GDL systems. Our results also suggest that nighttime restrictions on teenage driving reduces nighttime fatal crashes among drivers aged 16-17 compared to drivers in other age groups, with midnight restrictions producing somewhat more robust reductions than the 11 p.m. or earlier restrictions. The relative reduction in nighttime versus daytime crashes among 16- and 17-year-old drivers was also significant (Fell, Todd, & Voas, 2011a).

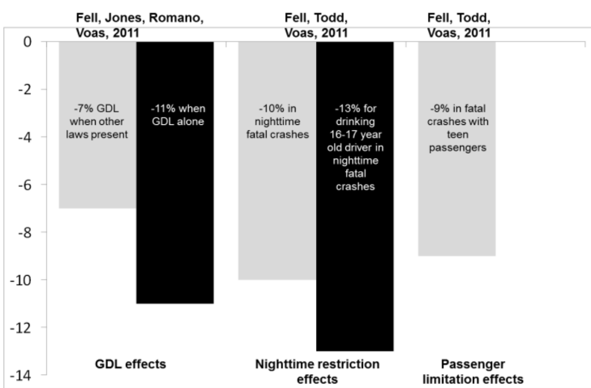

Figure 1. Effects of GDL laws and nighttime and passenger restrictions

The relative reduction in fatal crashes for drivers aged 16-17 with teen passengers versus without teen passengers was significant. The teen passenger limitation was significant only when the comparison was between years without any teen passenger restrictions and the years with the strictest possible limits (i.e., no teen passengers permitted) (Fell, et al., 2011a). Figure 1 summarizes the effects from our first two studies.

In our third study, we found differential effects of GDL laws depending upon the young driver's race and ethnicity. The analysis of states with GDL laws enacted between 2000 and 2007 showed no change for young (aged 16-17) Hispanic drivers in fatal crashes before and after a GDL law was adopted. Overall, GDL reductions were largest and significant for young White drivers, followed by African-Americans, and then Asians, with no significant reductions for young Hispanics. GDL laws also had no apparent effect on speeding-related fatal crashes for any of these novice drivers (Romano, Fell, & Voas, 2011).

Conclusion

States without the nighttime or passenger restrictions in their GDL law should strongly consider adopting them. A recent national survey revealed that Americans support GDL provisions: 70% favored nighttime driving restrictions, and 65% favored limited teen passengers for novice drivers.

Discussion

A recent study of GDL laws (Masten, Foss, & Marshall, 2011) found substantial reductions in fatal crashes of 16-year-old drivers associated with the adoption of strong GDL laws (down 26%), but found increases in fatal crashes for 18-year-olds in those same states (up 12%). The authors suggested that strong GDL laws might have delayed licensure of many youth until they were aged 18 to avoid all the GDL provisions and requirements. Our analysis is shown in Table 2.

Table 2. Estimated changes in fatal crashes and fatalities associated with the adoption of GDL laws in 50 states[a].

	"Any" GDL law			"GOOD" GDL Laws		
Effect measured: GDL law alone	% change[c]	$p \leq 0.05$? Y/N	Estimated number of lives saved or lost (S/L) in presence of any GDL law	% change[c]	$p \leq 0.05$? Y/N	Estimated number of lives saved or lost (S/L) in presence of a good GDL law
Age of driver[b]						
15	-5.9	N	692 (S)	-3.2	N	375 (S)
16	**-16.9**	**Y**	**1945 (S)**	**-20.4**	**Y**	**2347 (S)**
17	-5.4	N	779 (S)	-5.9	N	851 (S)
18	+4.4	N	1141 (L)	**+10.5**	**Y**	**2724 (L)**
19	+5.6	N	439 (L)	**+10.9**	**Y**	**855 (L)**
20	+0.10	N	76 (L)	+5.9	N	451 (L)

[a] Source: FARS. Methods from Fell, Jones, Romano & Voas (2011). [b] Age ratio used for estimate: Age/21-25. [c] Calculation performed assuming no change in ratio denominator (age/21-25) pre- and post-passage of GDL laws. Numbers in bold are statistically significant at $p \leq .05$.

Using the findings for each age that were significant ($p < .05$), 1,945 lives associated with GDL laws in general were saved by the reductions in fatal crashes involving drivers aged 16. For the "good" GDL laws, there was a net increase in fatalities of 377 due to the increase in fatal crashes by drivers aged 18, with an additional increase of 855 fatalities if the 19-year-old increase is included. "Good" GDL laws resulted in 2,347 lives saved due to the reduction of drivers aged 16 in fatal crashes but were associated with an increase of 2,724 fatalities from fatal crash involvements of drivers aged18.

The outcome of this effort indicates once more that GDL laws save the lives of the population they target: novice drivers aged 15-17. This favorable impact is even larger for the better GDL programs (i.e., the enacted GDL is "good"). These results also indicate that the lives of some drivers aged 15-17 saved by GDL laws are offset among the associated increases in fatal crashes by drivers aged 18-19. The reasons for the conflict in GDL benefits are unclear. They could be caused by (a) drivers aged 18-19 skipping the GDL phases and beginning to drive at a later age, reducing their driving experience; (b) drivers aged 18-9 exhibiting more risk-taking behaviors (e.g., impaired driving, lack of safety belt use, distracted driving) than younger drivers; (c) drivers aged 18-19 having increased exposure to risk for a fatal crash (e.g., more late-night driving; more driving on high-speed roads); and/or (d) drivers aged 18-19 who have gone through the two phases of GDL lacking driving experience under risky conditions because of all the restrictions in the GDL laws. Whatever the reasons, this finding suggests that GDL laws should be applied to protect novice drivers older than ages 16 and 17, perhaps up to age 21. Further research to clarify this finding is needed.

Acknowledgment

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Increasing impaired-driving enforcement visibility

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Abstract

An effective way to reduce impaired driving is to increase the perceived risk of being stopped and arrested by law enforcement if driving while impaired. One of the most successful strategies for doing this is the coupling of intense and highly visible enforcement with publicity about the enforcement campaign. The term "high-visibility enforcement" (HVE) is used to describe law enforcement efforts aimed at deterring driving after drinking by increasing the public's perception of being caught, arrested, and prosecuted for impaired driving. Examples of impaired-driving HVE programs are provided for regional, state, and local agencies considering incorporating HVE strategies into their efforts to curb impaired driving or to modify existing HVE programs. Six case studies of HVE programs currently operating in the United States provided the basis for these examples. HVE elements include the use of lighted or variable message signs; high-intensity lights; large signs announcing the enforcement; and large vans, trailers, patrol cars, and police officer vests with specialized impaired-driving enforcement insignias. Publicity activities include press releases, earned media coverage, letters to the editor, and signs, marques, posters, and billboards in the community publicizing the enforcement. Common enforcement strategies of HVE operations include sobriety checkpoints and saturation patrols. Checkpoints concentrate law enforcement officers at the roadside to identify impaired drivers passing through. Saturation patrols involve an increased number of officers patrolling a limited area where impaired driving is prevalent. Both use highly visible elements to heighten their overt impact. Enforcement efforts should also be supported by a substantial amount of publicity and communications. Publicity regarding the HVE operations raises public awareness and the perception of an increased likelihood of detection of impaired driving. Research has indicated that HVE operations that are well publicized, conducted frequently, and have high visibility can significantly deter impaired driving.

Context

Substantial progress has been made in reducing impaired driving in the United States since the early 1980s. According to the Fatality Analysis Reporting System (FARS), 10,839 people were killed in alcohol-impaired driving crashes in 2009. This accounted for 32% of the total traffic fatalities in that year. The proportion of all drivers involved in fatal crashes estimated to have been legally intoxicated (blood alcohol concentration [BAC] ≥.08 grams per deciliter [g/dL]) has decreased from 35% in 1982 to 22% in 2009. However, since 1997, that percentage of drivers in fatal crashes with illegal BACs has remained stagnant at 21 to 22%. These percentages range from a low of 12% in the state of Utah to a high of 31% in the state of Montana. The variability within states (i.e., at the community level) is likely to be similar.

Among the many reasons for this wide variability in the states are the strategies used for impaired-driving enforcement. States with highly visible, highly publicized impaired-driving enforcement programs tend to have lower impaired-driving rates. Georgia is a good example. It has had highly visible, frequent, publicized sobriety checkpoints conducted throughout the state for the past several years (Fell, Langston, Lacey, Tippetts, & Cotton, 2008). Georgia now has one of the lowest impaired-driving rates in fatal crashes in the nation.

Although alcohol-impaired driving fatalities did decrease 7.4% from 2008 to 2009 (from 11,711 to 10,839), fatalities not involving an alcohol-impaired driver decreased by a greater percentage (10.7%), decreasing from 25,712 in 2008 to 22,969 in 2009. An additional estimated 200,000 people were injured in impaired-driving crashes in 2009. Many experts believe that public complacency, competing social and public health issues, and the lack of political fortitude have all contributed to the stagnation in progress. It seems apparent that political leaders need guidance on which measures will affect the problem and stakeholders need to be motivated once again to implement effective strategies. The solutions to impaired driving in the United States lie mainly at the state and community levels. That is where the laws are applied and enforced, where programs are implemented, and where changes can be made. Among the most successful strategies is the coupling of intense and highly visible enforcement with publicity about the enforcement campaign. The focus of this enforcement strategy is to deter driving after drinking in the first place by increasing the public's perception of being caught, arrested, and prosecuted for impaired driving (a general deterrent strategy).

Research has indicated that well-publicized, frequently conducted, highly visible sobriety checkpoints deter impaired driving (Epperlein, 1985; Lacey et al., 1986a; 1986b; Levy, Asch, & Shea, 1990; Levy, Shea, & Asch, 1988; Voas, Rhodenizer, & Lynn, 1985; Wells, Preusser, & Williams, 1992). An evaluation of a demonstration program in Tennessee (*Checkpoint Tennessee*), using interrupted time series, showed a 20% reduction in alcohol-related fatal crashes when compared to projected alcohol-related fatal crashes if the program had not been implemented. It was also reported that the effects of the program extended at least 21 months after conclusion of the formal program (Lacey, Jones, & Smith, 1999). Lacey, Kelley-Baker, Ferguson, and Rider (2006) documented that low-staff checkpoints, publicized through earned media approaches, can be conducted weekly in relatively small and rural communities and can reduce alcohol-impaired driving dramatically. In a systematic review of the evidence, conducted by a Centers for Disease Control and Prevention (CDC) panel of experts (Shults et al., 2001), 15 studies on the effectiveness of sobriety checkpoints were summarized. A meta-analysis was conducted that showed a median reduction of 20% in fatal and injury crashes associated with sobriety checkpoint programs. The CDC panel concluded that these studies "provide strong evidence" that sobriety checkpoints are effective in preventing alcohol-related fatalities and injuries. Visibility and community awareness of these checkpoint programs played a key role in their success. An examination of FARS data in 2010 found that, in states that report conducting sobriety checkpoints weekly, 34% of the drivers in fatal crashes were drinking (BAC>.01 g/dL) compared to 38% in states that conduct checkpoints infrequently and 41% in states that do not conduct checkpoints.

Objectives

For this project, we documented the key features of six impaired-driving (or driving while intoxicated [DWI]) enforcement programs designed to increase public visibility, using various sources and data-collection methods. We collected the following for each case study:

Which regions, states, communities, or police agencies are conducting the program? What highly visible enforcement strategies are being used? Where is the enforcement strategy being conducted (town, city, county, community, state, region)? When did the program start? Is it ongoing? Have there been changes? How is the strategy implemented and conducted? How many law enforcement officers does it take? What are the visibility components? Is there any evidence of success? Is the program increasing visibility? How? Is there evidence of a decrease in impaired driving associated with the program?

After a thorough review of numerous potential program sites, six programs were selected for case studies: (a) *Checkpoint Strikeforce* (conducted in the Region III states of Delaware, Maryland, North Carolina, Virginia, and West Virginia, and the District of Columbia); (b) Charles County Sheriff's Office (Charles County, Maryland); (c) Anoka County, Minnesota; (d) Southeast Wisconsin High-Visibility Operating-While-Impaired (OWI) Task Force (Wisconsin); (e) Pasco County Sheriff's Department in conjunction with the New Port Richey Police Department (Pasco County, Florida); and (f) Escondido Police Department (Escondido, California).

Key Outcomes

HVE elements

Following each case-study report is a summary of its HVE elements. The following are an accumulation of HVE activities used by law enforcement operations in the six case studies:

1. Data-driven identification of problem sites, using data related to alcohol-impaired crashes, DWI activity, and other criminal activity to identify areas most in need of HVE operations.

2. Sobriety checkpoints, including:
   - Large-scale checkpoints, staffed by at least 10 people;
   - Small-scale checkpoints staffed by three to five people;
   - Happy-hour checkpoints operated between 4 p.m. and 7 p.m.;
   - Nighttime checkpoints operated between 9 p.m. and 2 a.m.;
   - Roving checkpoint operations that are set up and operated at one location, then broken down and moved to a new location the same evening;
   - Phantom checkpoints, in which police set up what appears to be a checkpoint with the signs and cones, but never actually conduct one, or have one police car present to ensure the equipment is not vandalized and take action if a passing vehicle displays erratic driving behavior; and
   - Holiday or special occasion checkpoints (e.g., Saint Patrick's Day or Monday Night Football checkpoints to address increased drinking associated with those occasions).

3. Saturation patrols in which an increased number of police cars patrol a segment of roadway or a neighborhood and trained law enforcement officers look for drivers who show signs of impairment. These special DWI patrols are generally conducted at the times and places where impaired-driving crashes and/or DWI arrests are occurring. To increase visibility, some of the saturation patrols are conducted during happy hours and on holiday weekends.

Fig 1. Aerial View of Checkpoint Strikeforce DUI Enforcement in Fairfax Virginia

Visibility

High-visibility elements of checkpoint and saturation patrol operations are used to increase the visibility and clear purpose of the operations. These elements include the following:

Fig 2. Digital Sign Posted During Checkpoint Strikeforce Enforcement in Maryland

- Lighted and/or variable message signs placed near the entrance of a checkpoint operation or segment of roadway associated with a saturation patrol to notify drivers of the checkpoint or saturation patrol.
- High-intensity lights that increase the visibility checkpoint operations. They also provide extra lighting for law enforcement to work by and increase safety.
- Large, reflective signs placed near the entrance of a checkpoint operation or a segment of roadway associated with a saturation patrol to notify drivers of the operation.
- Large vans or trailers with specialized insignia often used for breath or blood testing, booking offenders, and administrative workspace. Often, reflective police insignia and anti-DWI slogans are used to add visual impact to the HVE operations.
- Specialized insignia (e.g., magnetic signs) on patrol cars, especially those associated with saturation patrols, identify them as being part of DUI or DWI enforcement efforts.
- Specialized insignia on officers (e.g., badges or lettering on reflective vests) identify them as being part of the anti-DWI efforts. These can be worn by officers both at checkpoints and on saturation patrols so that DWI enforcement is more evident to passing motorists when the officers are out of their vehicles during traffic stops.

Media

Publicity is essential to raise awareness of enforcement operations and educate the community about impaired-driving issues. Publicity includes the following:

- Paid or earned media on television, on the radio, in newspapers, on billboards, etc.
- Press releases from program officials to local media to encourage news stories about program activities.
- Letters to the editor and articles by program officials for publication in the local media.
- Mock checkpoints conducted for the news media to demonstrate how checkpoints operate, raise media interest in checkpoints, and potentially provide video footage for future television news stories.
- Signs on marquees used to raise awareness of anti-DWI activities. Similar to movie theatre marquees, these changeable signs are used by many local businesses, churches, schools, and other enterprises.
- Posters, coasters, etc., in local bars and restaurants with anti-DWI information specific to local enforcement activities.
- Flyers or cards given to motorists at checkpoints or traffic stops.
- Posters and billboards used to promote enforcement efforts.

Conclusions

HVE strategies can be creative and flexible. They need not depend on the use of sobriety checkpoints. In several states in which sobriety checkpoints are not allowed, agencies conducting HVE activities have nevertheless incorporated many of the high-visibility elements normally associated with checkpoints (e.g., publicity in media, increased concentration of law enforcement officers, lighted signs, reflective vests) into their HVE strategy.

Additional guidelines

Based upon information gathered in the case studies and discussions with case study officials, communities interested in developing and conducting an HVE program should consider the following:

1. Identify the impaired-driving problem in the community. How many deaths, injuries, and traffic crashes are associated with impaired driving? Where does impaired driving stand as a public health issue in the community? Is it on the radar screen? If not, get the numbers and compare them to other public safety issues in the community that are receiving attention.

2. Is there a local impaired-driving or traffic safety task force, coalition, or council? If so, use them to provide the foundation and support for the HVE program. If not, make an effort to create such a task force. This can provide the impetus to initiate the HVE program.

3. What are the existing resources for impaired-driving enforcement? Can resources be combined with other law enforcement agencies? Combining resources can help to sell the HVE program.

4. Are sobriety checkpoints allowed in the state? Are they conducted in the community? If so, they can be the centerpiece of the HVE effort. They have inherent high-visibility qualities. If not, other highly visible strategies should be considered (for example, saturation patrols with patrol cars marked “DWI Enforcement”).

5. Are there potential barriers or opposition to HVE in the community? If so, work with those groups or organizations to come up with compromises that will satisfy all parties.

6. Determine whether political support can be obtained from community leaders to conduct an HVE program (e.g., mayor, county supervisors, sheriff). Political support can speed up the implementation process.

7. Try to enlist local businesses and transportation alternatives as support for the program. They can help publicize the enforcement efforts and provide alternatives for would-be drinking drivers.

HVE impaired-driving strategies have the potential to initiate progress once again in the United States in reducing impaired-driving crashes, injuries, and fatalities.

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Web site: *Increasing Impaired-Driving Enforcement Visibility: Six Case Studies,* DOT HS 811 716, February 2013.

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Self-regulation and Simulated Driving Performance of DUI Offenders in Sober and Intoxicated States

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Abstract

Background

Alcohol-related traffic injuries and fatalities continue to be a major public health problem, prompting the need for research aimed at identifying characteristics of DUI drivers in efforts to improve treatment and prevention. Although DUI offenders report traits of impulsivity, suggesting poor inhibitory control and heightened reward sensitivity, the specific cognitive characteristics underlying such behavioral dysregulation have not been systematically studied in the laboratory.

Aims

The purpose of the research was to directly evaluate driving performance and levels of inhibitory control in DUI offenders to test hypotheses that these high-risk drivers display deficits in mechanisms of self-regulation and display heighten sensitivity to the impairing effects of alcohol on their inhibitory control and their driving performance.

Methods

Study 1 compared DUI offenders (n = 43) to control drivers with no history of DUI (n = 33). Subjects performed laboratory tasks that included a measure of inhibitory control (i.e., go no-go task) and simulated driving performance. Group differences in task performance were examined. In Study 2 DUI offenders (n = 12) were compared to controls (n = 12) on their inhibitory control and driving performance following a dose of 0.65 g/kg alcohol and a placebo.

Results

DUI offenders displayed poorer driving performance compared with controls on measures of driving performance that were indicative of impulsive/reckless driving (e.g., speeding, running red lights). Moreover, poor inhibitory control predicted increased speeding and running red lights in DUI offenders, but not in controls. With respect to alcohol effects, DUI offenders displayed greater impairment of driving performance following alcohol compared with controls. Alcohol also impaired inhibitory control.

Discussion and Conclusions

The findings are important because they identify deficits in driving performance among DUI offenders that could be consequences of heightened impulsivity in this population, especially in

response to alcohol. Understanding the specific behavioral outcomes associated with impulsivity among DUI offenders could contribute importantly to our understanding of the factors underlying their decisions to drink and drive.

Introduction

Driving records show that DUI offenders commit more moving violations, such as speeding, and are involved in more accidents compared with the general population (Bishop, 2011). Personality inventories of DUI drivers reliably show high levels of impulsivity and sensation-seeking (Hubicka et al., 2010). Together, these lines of evidence suggest that DUI drivers can be characterized by patterns of impulsive action and risk-taking that are evident in driving behavior. Impulsivity reflects an imbalance in these countervailing mechanisms due to poor behavioral inhibition and/or heightened reward-seeking. (Fillmore & Weafer, 2011). Work in our laboratory has shown that deficient inhibitory control can contribute to reckless driving in a driving simulator (Fillmore et al., 2008). Drivers with poor inhibitory control are more likely to speed, run red lights, and display poorer driving precision.

Impulsivity might also result in increased sensitivity to the impairing effects of alcohol on driving performance. Survey-based studies find that individuals who score high on measures of impulsivity report histories of alcohol-related accidents (Miller & Windle, 1990). Such evidence has led many to hypothesize that the impairing effects of alcohol on driving performance might be exacerbated by poor impulse control (e.g., Jonah et al., 2001).

Despite numerous studies showing that DUI offenders self-report traits of impulsivity, the specific cognitive characteristics underlying such behavioral dysregulation have not been systematically studied in the laboratory. Nor has research examined how such characteristics might promote poor driving performance in this population, particularly under the influence of alcohol. The purpose of this research was to directly evaluate driving performance and levels of inhibitory control in DUI offenders to test hypotheses that these high-risk drivers display deficits in impulse control and heightened sensitivity to the impairing effects of alcohol on their inhibitory control and their driving performance. Study 1 compared DUI offenders to control drivers with no history of DUI. Subjects performed laboratory tasks that included a measure of inhibitory control (i.e., go no-go task), and simulated driving performance. Study 2 examined the acute effects of alcohol on driving performance and inhibitory control of DUI offenders and controls.

Study 1: Analyses of Driving Performance and Inhibitory Control

Subjects

Subjects were 76 adults between the ages of 21 and 40 years. Forty-three subjects were DUI offenders (31 men and 12 women) and 33 subjects were non-offender, control subjects (19 men and 14 women). DUI subjects had to have at least one DUI offense in the past 5 years. Control subjects had no history of any arrests/convictions for DUI. All subjects completed a comprehensive driving history questionnaire that included measures of driving experience (e.g., years driving, weekly distance driven), as well as reports of license revocations, traffic violations, and DUI offenses. DUI convictions were also verified by state district court records. All subjects held a valid driver's license for at least 5 years and drove on a regular (i.e., weekly) basis. Subjects were recruited by newspaper, websites, and community bulletins that invited individuals to participate in studies of driving skill and behavioral effects of alcohol. Some advertisements specifically targeted adults with previous DUI offenses. All subjects were current consumers of alcohol. Their typical quantity and frequency of drinking was measured. The University of Kentucky Medical Institutional Review Board approved the study, and subjects received $50 for their participation.

Apparatus and Materials

Simulated Driving Task A computerized driving simulation task was used to measure driving performance (STISIM Drive, Systems Technology Inc., Hawthorne, CA). In a small test room, subjects sat in front of the computer display that presented the driving simulation. The driver was placed in the cab of the vehicle, providing a view of the roadway and dashboard instruments. Drivers controlled the vehicle by moving a steering wheel and manipulating accelerator and brake pedals. The task required subjects to drive 6 miles in a traffic-laden, urban setting. Drivers were instructed to obey all traffic and speed limit signs. The test yields several measures of driving performance. Two primary measures of driving precision are deviation of lateral lane position and rate of steering maneuvers. Poorer driver precision is indicated by greater deviation of lane position accompanied by faster steering maneuvers. Measures of "risky driving" were also examined, such as speeding and failures to completely stop at red lights (i.e., stopping failures).

Cued Go/No-go Task Subjects' inhibitory control was measured by the cued go/no-go task. This reaction time task requires subjects to respond quickly to go targets and inhibit responses to no-go targets. Response inhibition is measured by the proportion of no-go targets in which subjects fail to inhibit a response (p-inhibition failures).

Procedure

Subjects attended a single test session. They completed background and screening measures and were familiarized with the driving simulator and go/no-go task. After screening and familiarization, subjects performed the tasks.

Results

There was no significant group difference in age ($p > .05$). The mean ages of DUI offenders and controls were 26.1 ($SD = 5.1$) and 27.0 ($SD = 6.2$) years, respectively. There were also no significant differences in driving experience ($ps > .05$). The sample had been driving for a mean of 11.1 years ($SD = 21.1$) and drove an average of 5.3 days per week ($SD = 2.2$). With regard to drinking habits, DUI offenders reported consuming more drinks per occasion than controls ($p = .043$). DUI offenders reported a mean of 5.1 drinks ($SD = 2.5$) and controls reported 4.0 drinks ($SD = 2.2$). There was no group difference in drinking frequency ($p > .05$). On average the sample drank 2.5 times per week ($SD = 1.8$).

Analyses of driving performance showed that DUI offenders displayed significantly poorer driving performance compared with controls on multiple measures of driving performance. Compared with controls, DUI offenders drove faster, had more stopping failures at red lights, and showed greater deviation within their lane. Mean driving performance measures for each group are reported in Table 1. There was no significant group difference in inhibitory control ($p > .05$). However, correlational analyses showed that poor inhibitory control predicted increased speeding and running red lights in DUI offenders ($ps < 0.05$), but not in controls ($ps > 0.60$).

	Controls		DUI Offenders			
	M	(SD)	M	(SD)	*T*	*P*
Speed	39.95	(5.96)	44.12	(8.54)	2.51	0.01
LPSD	0.93	(0.22)	1.37	(1.20)	2.37	0.02
Stop failures	0.52	(0.80)	0.93	(1.01)	2.01	0.04
Finish time	537.97	(84.61)	495.39	(93.12)	2.08	0.04
Inhibition fails	0.035	(0.042)	0.047	(0.065)	0.91	0.36

Table 1. Speed = average driving speed (mph); LPSD = lane position standard deviation (feet); Stop failures = number failures to completely stop at red lights; Finish time = time to complete drive (seconds); Inhibition fails = proportion of inhibition fails to no-go targets.

Study 2: Effects of Alcohol on Driving Performance

Subjects

Subjects were 12 DUI offenders (9 men and 3 women) and 12 controls (4 men and 8 women). As in Study 1, subjects completed background measures on driving and alcohol use and general demographics. Volunteers were excluded if their current alcohol use met dependence/withdrawal criteria as determined by the *Structured Clinical Interview for DSM-IV (SCID-IV*). All participants were at least 21 years old, and women who were pregnant or breast-feeding, as determined both by self-report and urine sample, were not allowed to participate.

Procedure

Subjects attended a familiarization session during which they completed background information and practiced the go/no-go task and a simulated driving test that emphasized driving precision and vigilance. The test required subjects to drive 15 miles in a rural setting comprised of a winding road and occasional hills. Driving measures included within-lane deviation (LPSD), rate of steering movement (mean per second degree change in steering wheel), and center lane and road edge line crossings.

All subjects were tested under two doses of alcohol: 0.0 g/kg (placebo) and 0.65 g/kg. Each dose was administered on a separate test session (i.e., test day), and dose order was counterbalanced across subjects and groups. The dose produces an average peak BAC of 80 mg/100 ml at approximately 70 min. The placebo consisted of a volume of carbonated mix that matched the total volume of the 0.65 g/kg alcohol drink. Testing on the driving test and cued go/no-go task began at 20 min after drinking and was completed 55 min after drinking. Subjects also completed visual-analogue scales to assess subjective effects (e.g., self-estimates of BAC, perceived intoxication, ability and willingness to drive) at regular intervals during the descending phase of the BAC curve at: 70, 115, 160, 205, and 250 min post drinking.

Results

There were no significant group differences in age, driving experience, or drinking habits (ps >.05). The groups did not differ in BAC following alcohol administration (ps >.05). The mean (SD) BAC in mg/100 ml at each time interval was: 20 min = 47.0 (16.4), 40 min = 60.1 (13.5), 60 min = 60.1 (10.7), 70 min = 68.9 (10.3), 115 min = 54.3 (10.5), 160 min = 42.6 (9.6), 205 min = 32.5 (10.0), and 250 min = 21.1 (10.3).

The primary measures of driving performance were steering rate, LPSD, and line crossings. A 2 (group) X 2 (dose) ANOVA of drivers' steering rate scores obtained a significant group X dose interaction, $F(1,22) = 5.8$, $p = .024$. Figure 1 plots the interaction. The figure shows that DUI offenders and controls displayed similar steering rates when tested under placebo (i.e., 0 g/kg alcohol). However, when tested under 0.65 g/kg alcohol, DUI offenders displayed an increased steering rate compared with controls.

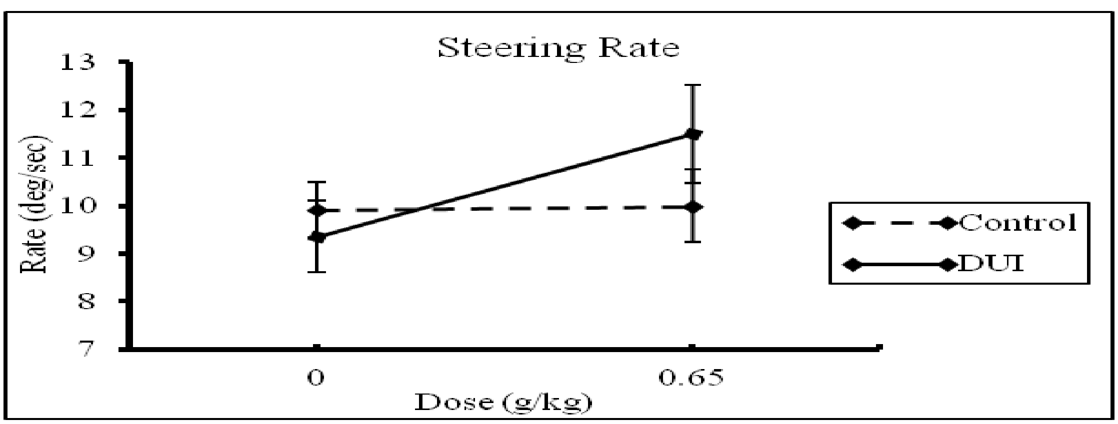

Figure 1. Mean steering rate in deg/sec following 0.0 g/kg and 0.65 g/kg alcohol for DUI and control drivers.

Analysis of LPSD scores obtained a significant main effect of dose, $F(1,22) = 9.1$, $p = .006$. LPSD increased under alcohol (1.15 feet, SD = 0.48) compared with placebo (0.96 feet, SD = 0.32). Although the sample showed more crossings under alcohol (mean = 15.4, SD = 25.0) than placebo (mean = 9.4, SD = 2.6), the main effect of dose did not attain statistical significance, $F_{(1,22)} = 3.5$, $p = .073$. Analysis of subjects' p-inhibition failure scores on the cued go/no-go task obtained a significant main effect of dose, $F(1,22) = 9.1$, $p = .006$. The proportion of inhibition failures increased under alcohol (0.145, SD = 0.14) compared with placebo (0.07, SD = 0.10).

Analyses of subjective effects showed that, under alcohol, DUI offenders reported a greater ability and willingness to drive, and lower self-estimated BACs compared with controls ($ps < .05$).

Discussion and Conclusions

The results show that, in the sober state, DUI offenders drove faster, had more failures to stop at red lights, and showed greater deviation within their lane. Moreover, this reckless driving behavior was related to the DUI offenders' poor inhibitory control. With regard to alcohol effects, DUI offenders displayed a greater increase in steering rate compared with controls that was indicative of abrupt, quick steering maneuvers. Also under alcohol, DUI offenders estimated their BAC to be lower than controls and perceived themselves as more able and willing to drive than controls. Taken together, the findings suggest that DUI offenders have heightened sensitivity to the behaviorally disruptive effects of alcohol on their driving performance that might be due in part to poor inhibitory control. At the same time, DUI offenders appear to have reduced self-perceptions of such impairments. The findings highlight how reduced inhibitory control coupled with poor self-evaluation could underlie risky decisions to drive after drinking.

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Alcohol-related driving offences, crashes, and traffic policing strategies in Zhejiang Province, China.

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Abstract

Context
Alcohol-related traffic offences and associated trauma have attracted attention in China in recent years, culminating in changes to national legislation in May 2011. Harsher penalties were introduced, particularly for offences where blood alcohol concentration (BAC) levels above 80mg/100mL are recorded. Deemed to be drunk under the law, this is now a criminal offence attracting penalties including large monetary fines, licence suspension for 5 years and imprisonment.

Objective
This paper outlines key statistics about alcohol-related road trauma in Zhejiang Province and strategies used to combat drink- and drunk-driving.

Key outcomes
Zhejiang Province, in China's south east, has a population of approximately 54, 426,000; 22.36% hold a driving licence. Rapid motorisation is occurring there. In 2011, 1,383,318 new licences were issued, representing a 16.78% increase from the previous year. In 2012, there were a total of 65,000 police officers throughout the Province, 12,307 of whom (18.9%) were traffic police. Responsibility for conducting alcohol testing is the responsibility of all traffic police. The number of alcohol breath tests conducted per year was not available. However, traffic police are actively enforcing alcohol-related laws. In 2011, 89,228 drivers were charged with drink-driving (DUI;20-80mg/100 mL) and 10,014 with the more serious drunk-driving offence (DWI;>80mg/100mL) (Zhejiang Traffic Management Department, 2012). These numbers decreased from the previous year (221,262 and 26,390 respectively). For all crashes recorded in 2011 (n=20,176), 2% involved alcohol-impaired road users. Information on the role of alcohol in crashes from previous years was not available.

Discussion

Various strategies are employed to detect alcohol-impaired drivers including: targeting vehicles from hotels/restaurants; using sense of smell to screen drivers for further testing; passive alcohol sensors to test drivers; and blood tests for crash-involved drivers where a fatality occurred. Although resources to promote road safety are limited, various government initiatives promote awareness of the dangers of alcohol-related driving and more are needed in future.

Introduction and context

The dramatic and unprecedented economic growth in China in recent history has been accompanied by large increases in vehicle ownership, with China now experiencing one of the highest annual motorization growth rates in the world (Pendyala & Kitamura, 2007). The number of people obtaining a licence for the first time has also risen dramatically (Zhang et al., 2013). Increases in personal disposable incomes, together with the desire to avoid over-crowded public transport and experience the freedom and status associated with personal car ownership and use, have all aided this rapid expansion in driving participation (Fleiter, et al., 2012).

Unfortunately, this unprecedented growth in vehicles and drivers has also meant that China's road trauma burden is high. Road crashes have been reported as the leading cause of death for those aged up to 45 years and the number one non-disease killer (Pendyala & Kitamura, 2007; Zhang et al., 2013). Although estimates and definitions of road traffic fatalities differ (see Li et al., 2012; Ma et al., 2012; World Health Organization, 2013), there is recognition that reducing road crashes and associated human trauma is an important issue requiring multi-sector efforts in China. The contribution of alcohol to the problem is difficult to quantify, yet has received increased attention in China in recent years. Alcohol plays an important role in many parts of Chinese society (Cochrane et al., 2003). Increasing annual alcohol consumption rates, together with the rapid increases motor vehicle ownership and driving participation, warrant the need to consider that alcohol-related road fatalities may also increase, unless effective countermeasures are introduced (Li et al., 2012).

Alcohol-related driving regulations in China

In recognition of the need to better control alcohol-related driving, the Chinese government introduced 2 categories of alcohol-related traffic offences in 2004. The offence of 'drink driving' (DUI) defined offenders with a BAC of between 20mg/100mL and 80 mg/100mL. The more serious offence of 'drunk driving' (DWI) defined offenders with a BAC exceeding 80 mg/100mL. In May 2011, penalties were increased to further deter alcohol-related driving offences, with the 'drunk driving' offence experiencing the biggest change. This offence became a criminal offence attracting penalties including large monetary fines, licence suspension for 5 years, imprisonment, and a potential lifetime ban on driving (see Li et al., 2012 for a detailed explanation of regulations and penalties).

From a national perspective, there is no clear picture available to describe the drink/drunk driving rates in China (Li et al., 2012). With regard to alcohol-related crash and fatality statistics, data from the annual reports of the Ministry of Public Security indicate that nationally, fewer than 3% of crashes and approximately 4% of fatalities were the result of alcohol-related driving in the period 2001-2009 (cited in Li et al., 2012). It is possible that these figures are under-reported owing to factors such as police officers only being able to nominate the leading cause of crash when there may in fact be multiple causes, and a lack of routine alcohol testing on all crash-involved drivers during that period (Li et al., 2012).

Zhejiang Province

Zhejiang Province, located on China's south east coast, had a recorded resident population of 54, 426,891 at the end of 2011 (Zhejiang Public Security Bureau, 2012). It is recognised as one of the wealthiest and fastest growing provinces in the nation. In 2007, it accounted for approximately 6.8% of the country's gross domestic product with approximately 4% of the national population (Ye & Wei, 2007). The ongoing development of Zhejiang has been accompanied by rapidly increasing motorisation rates. Information obtained from the provincial traffic management authority revealed that at the end of 2011, the province had a total of 6,582,445 registered vehicles (excluding tractors and motorcycles) and a total of 1,383,318 new licences were issued throughout 2011, representing a 16.78% increase from the previous year. Approximately twice as many men (9,027,532) as women (3,929,569) were licence holders and overall, 22.36% of the population held a licence in 2011 (Zhejiang Traffic Management Department, 2012). A feature of Zhejiang's motorisation has been a rapid increase in ownership and use of the electric bicycle, a powered 2-wheel vehicle, also known as an e-bike, that weighs less than 40 kilograms and has a top speed of 20 kilometres/per hour (Feng et al., 2010). In Zhejiang's capital city, Hangzhou, between 2004 and 2008, the death rate associated with this vehicle type reportedly increased more than 6-fold and the injury rate, almost 4-fold (Feng et al., 2010).

In 2011, a total of 20,176 road crashes were recorded in Zhejiang Province, resulting in 5,235 fatalities and a total of 21,260 people injured (Zhejiang Traffic Management Department, 2012). These numbers represent 9.57%, 8.39%, and 8.95% of the national crash, fatality and injury figures, respectively (National Bureau of Statistics of China, 2012). Also in 2011, the number of motorists charged with a drink-driving offence (DUI; 20-80mg/100 ml) was 89,228. The number charged with the more serious drunk-driving offence (DWI; >80mg/100ml) was 10,014 (Zhejiang Traffic Management Department, 2012).

Encouragingly, these numbers reportedly decreased from the previous year (DUI = 221,262 and DWI = 26,390, representing reductions of 68% and 60%, respectively, in 2010). For all crashes recorded in 2011, the Traffic Management Department reported that 2% involved alcohol-impaired road users. Unfortunately, the role of alcohol involvement in crashes, fatalities and injuries for the Province was not available for previous years. This figure of 2% is consistent with published national figures from the Ministry of Public Security as cited above. It is noted, however, that this figure is substantially lower than results of work conducted in another Chinese Province between 2006 and 2009. A study conducted by the Global Road Safety Partnership in Guangxi Province suggested that rates of alcohol involvement might be higher. Crash survey results from 2 cities revealed that an average of 34.1% of road crashes were alcohol-related and the largest proportion of these crashes (22.9%) involved drivers with a BAC of 80mg/100mL or higher (Yuan, et al., 2010; Yuan et al., 2013). However, it is possible that such discrepancies could be due to a range of factors, including that the Guangxi study was conducted before the stricter penalties for drunk-driving were introduced in May 2011.

Alcohol enforcement in Zhejiang Province

Enforcing alcohol-related traffic laws is the responsibility of the traffic police in China. In 2012, there were a total of 65,000 police officers throughout Zhejiang Province, 18.9% (12,307) of who were traffic police. Responsibility for conducting alcohol testing of road users is the responsibility of all traffic police. The number of alcohol breath tests conducted per year was not available. However, traffic police report actively enforcing alcohol-related laws using a variety of countermeasures. A key strategy used by police is to target their operations on vehicles leaving hotels, restaurants and entertainment areas. Roadside alcohol testing is currently conducted mostly during evening and early morning hours.

Police officers also employ the use of their sense of smell to screen drivers who are stopped at road side testing areas. When police officers establish a check point, they may stop every vehicle in the traffic stream, or select vehicles at random. Once a vehicle is stationary, the police officer initiates a conversation with the driver. If the officer smells alcohol during this conversation, the driver can be asked to undergo further testing to confirm whether they have consumed alcohol and whether they are within legal BAC limits. Traffic police may also use passive alcohol sensors while the driver remains in the vehicle. This device is less 'invasive' and potentially less time consuming than a full breath or blood test and is used to screen for the presence of alcohol in the breath. Although no data describing the use and effectiveness of these devices in China is currently available, passive alcohol detectors have previously been shown to have a high correlation with other evidentiary testing procedures and to be an effective means of screening drivers in the USA (Farmer et al., 1999; Foss et al., 1993). If a driver's reading on the passive alcohol sensor device is above .08, the driver is taken by police officers to a hospital where a blood sample is taken for confirmation. In addition, wherever practical, all attempts are made to take a blood sample (at hospital) of crash-involved drivers where a fatality has occurred.

Community awareness campaigns about risks of drink driving

It is acknowledged that there are many competing interests in the public health domain in China. As the country continues to develop, road safety is only one of many areas where greater public awareness is needed. There are many competing interests and a finite amount of resources to devote to road safety education issues. Government agencies in Zhejiang Province have made a number of attempts to raise community awareness about the risks of drink/drunk-driving and related police enforcement efforts. For instance, many highways and major roads have billboards reminding drivers not to drink and drive. Electronic variable message signs are also used to raise awareness in some locations (see Figure 1).

The police also take active steps to raise public awareness of many traffic risks including drink driving. Every police department has a team who are responsible for communicating such issues to the public and the media. Information about serious traffic incidents, new traffic laws or rules, and safety measures are communicated via traditional and new media outlets. Television, radio, and print media are used to convey educational messages and there is increasing use of new media (internet and mobile phone networks) including police media blogs and short text messages to communicate with the public. In addition, many police officers give safety information during visits to companies, schools and community gatherings.

Figure 1: Electronic advertising in Zhejiang's capital city, Hangzhou. This message translates as "After drinking, do not drive. If you want to drive, do not drink".

In conclusion, in Zhejiang Province, there have reportedly been reductions in the incidence of alcohol-related driving offences in recent years with a large reduction occurring between 2010 and 2011. Traffic police take the lead role in enforcing the law and many initiatives have been implemented to raise public awareness of the dangers of alcohol consumption and driving, as well as about the consequences of being caught for an alcohol-related driving offence. Ongoing efforts are needed to continue to promote the risks of drink- and drunk-driving.

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Rehabilitation of drunk drivers and the SMADIT project: Collaboration between the Police Force, the Road Administration and the Social Services

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Abstract

The aim of the SMADIT project is to reduce the number of drunk drivers on the Swedish roads and reduce the number of repeated drunk driving offences. The project is a three way collaboration between the Swedish Police Force, the Swedish Road Administration and the Swedish Social Services. According to the guidelines the police should inform the suspected drunk drivers about SMADIT and ask if they want to be contacted by the Social Services. If they agree then a member of staff from the Social Services will contact them within 24 hours.

The purpose of this paper is to present the results from a qualitative study evaluating the effects of the SMADIT. Thirteen male drivers and one female driver who agreed to take part in the SMADIT project were interviewed. The questions covered their experience of SMADIT but also the circumstances behind their drinking and driving.

The results showed that the initial contact with the police determined if they would agree to participate in the project or not. An important aim with SMADIT project is the early contact with the Social Service but the results from this study showed that several of the informants needed time for reflection and to recover from the shock after being stopped by the police on suspicion of drunk driving. However, according to informants it was important that not too many days passed before a contact was established. During the meeting with the Social Service the informants were offered different kinds of treatment. All of the informants were very pleased with this contact.

According to the guidelines provided by the SMADIT project a consensus has to be reached otherwise the Social Services cannot contact the person. In this study we found that a person straight after the event does not always think clearly and we therefore propose that the SMADIT project is extended to also include those who initially reject the offer.

Introduction

Driving while under the influence of alcohol or drugs is a problem of great concern in Sweden as it is in many other countries. The legal limit for alcohol in Swedish drivers is a blood alcohol concentration (BAC) of 0.2 g/L whereas there is zero tolerance for drugs (except for medicinal drugs by doctor's prescription). An observational study in three counties in Sweden found that approximately 0.24% of the traffic volume comprised vehicles driven by people with blood alcohol over the legal limit (Forsman et al., 2007).

SMADIT is the name of a project aimed to reduce the number of drunk drivers on Swedish roads and is a collaboration between the Swedish Police Force, the Swedish Road Administration and the Social Services.The goal is that every suspected drunk or drug driver shall, as soon as apprehended by the police, be offered contact with the Social Services and, if needed, suitable treatment.

The purpose of this study was to evaluate the drunken driver´s perception of the SMADIT project.

Method

In order to evaluate the effect of the SMADIT project a qualitative approach with interviews was selected. The strength of a qualitative study is that it is flexible and can be adapted to the situation, thus contributing to a deeper understanding of a specific issue or phenomenon.

The suspected drunk drivers own stories and perspectives form the so-called dense descriptions (thick description), a contextual knowledge and understanding that can be used in conjunction with improvements of the SMADIT project. The qualitative research approach thus provides no statistical result. Instead of answering questions about how many and how much, the qualitative study includes questions about how and why (Holme & Solvang, 1997).

Prior to the interviews a short survey was sent to all 21 police authorities in Sweden. The purpose of this study was to establish how many drivers had been informed about SMADIT and how many had accepted the offer to be contacted by the Social Services.

Participants

In the present study, 14 suspected drunk drivers (1 female and 13 male) were interviewed about their perceptions and experience of the SMADIT method. The participants were between 35 and 60 years old, all of them employed living with a partner.

Procedure

Selection and recruitment of people to interview was done in cooperation with the different Police Authorities. The police officer handed over the information about the interview study to the suspected drunk driver. In addition to this drivers were also recruited via the Social Services who had contacted them after losing their license as a consequence of drinking and driving. After receiving the information it was up to the drivers themselves to contact the researcher and decide when and where to meet. The interviews usually took place at a library nearby or in their own home. The interviews were conducted with the help of an interview guide. The guide consisted of a number of open-ended questions, which in turn had several follow-up questions to give more space to the interviewee's own story and any spontaneous statements. Some issues covered related to procedures within SMADIT while others focused more on responses from the Police Force and Social Services. All the interviews were tape-recorded and then transcribed. Each interview took approximately 60 minutes.

Results

The results from the short survey with all the various Police Forces showed that 45 per cent of the suspected drivers were informed about SMADIT and among them about 27 per cent accepted the offer. These numbers are in line with earlier studies (Gustafsson & Henriksson, 2007; Hrelja with several, 2009).

The interviewed suspected drunk drivers stated that the drunken driving incident and the treatment was a turning point in their life. As a consequence of this most of the informants had stopped abusing alcohol. Also, the informants' family relationships and life situations have improved. The majority of the informants did not think they would drink and drive in the future.

Overall, informants argued that the SMADIT project was a good method to prevent drunk driving. Informants' narratives show that the way the police informed about SMADIT was very important. Most of the informants felt that being stopped by the police was very embarrassing. Therefore, police kindness and understanding was very important and seemed to contribute to the informants' acceptance to take part in the project. There were also other reasons which might have influenced their decision: Firstly, they were more likely to accept if they had a history of drinking and driving. The second reason was related to their emotional state after being stopped by the police. This meant that they were not fully aware of themselves signing the form which allowed the Social Services to contact them. Thirdly, some accepted the offer because they hoped that this would help them to retain their driving license since they were being co-operative. However, regardless of the reason the contact with the Social Services and subsequent treatment had helped them to overcome their problems with alcohol.

Conclusion

The aim of the SMADIT project is to reduce the number of drunk drivers on our roads. The results from this study showed that the contact with the police was crucial. Therefore it is important that the police inform about SMADIT and that they provide the suspected drunk driver with sufficient and accurate verbal information about the project.

Furthermore, the interviews showed that it was not necessary that the first contact with the Social Services took place within twenty-four hours as stipulated in the guidelines. Several of the informants indicated that they needed some time for reflection and to recover from the shock after being stopped by the police on suspicion of drunk driving. However, according to the informants, it was important that not too many days passed before a first contact and meeting is held.

The initial survey sent to the different Police Authorities showed that about half of the suspected drunk drivers who received information about SMADIT agreed to take part in the project. The reason for rejecting the offer might be that they are not in need of any treatment but it could also be that they do not want to admit to themselves that they have a problem. It could therefore be argued that people who do not want to take part in the project and be contacted by the Social Services should get a second chance. The police could ask them again when they are contacted some days later and when the key to the car should be handed back.

Finally, the police motivation to work with SMADIT can increase if the Social Services ask the suspected drunk driver for permission to give feedback to the police about the person's contact with them.

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An interview study with convicted drink drivers

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Abstract

This presentation will be based on two qualitative studies involving semi-structured interviews of convicted drink drivers. The studies included 26 drink drivers, mostly male, between the ages of 20 and 60. The participants were contacted through different rehabilitation centres. The interviews dealt with respondents' attitudes towards alcohol and driving from a general point of view and their views regarding rehabilitation. In one of the studies their experience and opinions about alcolock devices was discussed.

The results showed that the great majority of the respondents had previously driven under the influence of alcohol, although only two persons had previously been convicted of drunken driving. To drink and drive was often a question of not really reflecting over whether one was intoxicated or not. An additional explanation of why they still took the car was that they did not believe that alcohol made them poorer drivers. Generally speaking, the risk of an accident and/or being discovered was considered to be very small.

The respondents all agreed that the punishment in itself, i.e. losing the driver's licence, would not have been sufficient, and that they also needed support and help. With regard to alcolocks most of them had a relatively positive attitude towards this even though they had certain reservations. Their attitude towards alcolocks depended on how long it should remain fitted and the cost. However, some respondents considered that it was relatively easy to manipulate the device. To only participate in an alcolock program was not considered to be enough to help them to not drink and drive in the future. It could therefore be concluded that drink driving is often related to more deep seated problems and therefore a combination of measures are needed.

Introduction

Driving under the influence of alcohol is an important risk factor for traffic injuries. The legal limit for alcohol varies from country to country and in Sweden the blood alcohol concentration (BAC) is set to 0.2 g/L. The percentage of drivers who are over the limit is usually very low. A fairly recent study found that approximately 0.24% of drivers were over the limit (Forsman, Gustafsson & Varedian, 2007). In a country like Sweden where approximately 2.6 milliard journeys by car is made that would then mean that around 6 million journeys are carried out by a driver who is affected by alcohol.

Despite the fact that less than one per cent of all drivers are driving under the influence those who do contribute to a large number of fatal accidents. Jones et al (2009) presented results which showed that during 2003 to 2007 drivers who were over the limit were involved in 22% of all fatal accidents.

Different methods are used to reduce the number of drivers who drink and drive. One of them is random breath testing and the police conduct approximately 2.5 million breath tests per year. Another is sanctions; a blood alcohol level of 0.2‰ to 0.7‰ results in fines. At 0.8‰ and higher the persons driving license is suspended and in most cases it also result in a prison sentence for up to two years. As an alternative to driving licence revocation the driver can apply for a special driving licence which permits them to drive a car if it is equipped with an alcolock. The conditional period is two-years. The person has to pay for all the costs which include the alcolock rental fees plus doctor´s fees. The doctor´s fees are for medical check-up which is carried out to ensure that the person is not drinking alcohol (for further information see the Swedish Transport Administration webpage http://www.trafikverket.se). The alcolock programme started as a trial in 1999 and from the 1st of January 2012 it has become permanent. Recent data shows that during the first year 30% of the convicted drivers had applied to take part in the programme (Sjöström & Stenlund, 2012).

A number of studies have shown that drivers who drink and drive often have problems with alcohol and some of them can be described as suffering from alcoholism (Bergman et al., 2000; Glitsch, et al., 2000;. Kelly, Darke & Ross, 2004). In the study by Bergman et al (2000) more than half of the drivers who were suspected to be over the limit had problems with alcohol. They also found that this also applied to drivers with lower levels of alcohol. This then was the starting point for a project in Sweden which instead of a prison sentence offered the drivers to take part in a rehabilitation program. The program lasted one year and included group therapy. The aim of this paper is to present the results from two qualitative studies involving semi-structured interviews of convicted drink drivers

Method

Participants

Study 1: Eleven persons (ten men and one woman) charged with a drink-driving offence (exceeding a BAC level of .08‰) took part in the study. The participants had chosen to undergo a rehabilitation program instead of serving a one month imprisonment. Most of them had had a driving licence for quite a long time, several of them for more than twenty-five years. Five persons had applied for and had also had an alcolock device installed in their vehicles, whilst six persons had declined.

Study 2: Fifteen drivers convicted of drinking and driving took part (13 men and 2 women). people. The age of the drivers were between 20 to 60 and they had all been charged by the police and the offence was regarded as severe (exceeding a BAC level of .08 ‰) and had therefore lost their driving license and in some instances served a prison sentence.

Procedure

The procedure was the same in study 1 and 2 with one exception. In study 1 participants discussed their views on alcolock devices. Thus the method used was in-depth interviews carried out according to a fixed interview guide with opportunities for spontaneous comments. The interview started with a short introduction of the project and ensured that the material would be confidential. A tape-recorder was used but it was stressed that the participants could terminate the interview at any time by switching it off. Questions dealt with perception of risk, the effect of alcohol on driving and awareness of being over the limit. The interview also covered how they perceived themselves, if they had been over the legal limit before, if they had been charged with a drink-driving offence before and if they had problems with alcohol. All interviewees were at the end of the interview given a small compensation in shape of a voucher. All the interviews were transcribed and subject to analysis.

Results and discussion

The majority of drivers (n=21) admitted that they had a history of driving under the influence of alcohol. Two of the participants had to retake their driving license six and seven times. The two remaining people stressed that it was the first time although later in the interview it became apparent that this was not the case. The reason why they had driven while intoxicated on the most recent occasion could be divided into three groups; an extraordinary situation, pure routine, and the morning-after when they thought that the alcohol had left the body. Regardless of the reason, it was often a question of not really reflecting over whether one was intoxicated or not something which can be linked to their perception of their own ability to drive the car.

Driving ability

Only two of the participants believed that driving under the influence of alcohol made them a worse driver. Some of the participants did not feel drunk and therefore had no hesitation about driving. One woman argued that when she had been drinking she totally forgot about the risk. Another added that it was no problem because he had done it before. One of the participants who had been charged with 2.8‰ claimed that he did not feel like he was drunk and did not believe that his driving was any worse for it. He added that he had been driving many miles and that it was automatic. Thus he was driving as before adding “I am the best”. This was also reinforced by a belief that if they were stopped by the police it was a routine control and not because of their driving.

Perception of risk

Despite the fact that most of them did not perceive that the alcohol affected their driving some of them were aware of being over the limit and that the police could charge them with drinking and driving although the perceived chance of being stopped by the police was very small. One of the participants saw this as a gamble (“like a Russian roulette”) and tried to avoid police controls by using minor roads. If he saw the police at one place then he stopped using the same route for a period of time. On the other hand another man argued that when he drank alcohol he became completely numbed and therefore not aware of any risks at all. Several would argue that the internal restriction which usually stopped the person from drinking and driving ceased to work when they had been drinking.

Social norms

The response to the questions about the perception of people close to themselves was that some did not see it as a problem whereas others had a very strong norm against drinking and driving. Nevertheless, few of them felt that others would condemn them. Some had been met by the reaction that it could have happened to them. One conclusion from this, from the participants' point of view, was that drink driving was relatively common. The interviews also showed that the public did not always react when they saw an intoxicated driver. Some members of the public had phoned to the police but absolutely not everybody.

After the event

Straight after the event was usually a very difficult period and many expressed deep regrets and feeling ashamed of themselves. These feelings were coupled with the humiliation which they felt in connection with being caught, but also in being judged by those nearest to them. It was far more difficult to admit drinking and driving than any other driving offence. For instance, one man never told his son because he believed that this might reduce him in his sons' eyes. Those who felt the least shame were those who could transfer the responsibility to the situation, i.e. those who felt that they did not have any control over what had happened or that they could not have acted in any other way.

Interventions

Since the interviewed persons were either undergoing a treatment program (Rattfällan – The Steering Wheel Trap) or attending a day centre the question of how this had helped them was also discussed. The respondents all agreed that the punishment in itself, i.e. losing the driver's licence, would not have been sufficient, and that they also needed the support and help which the treatment could offer.

Before the treatment, many had denied that they had any problem with alcohol. As long as they could function in a reasonable way, that is having a partner and a job, it was not seen as a problem. To accept that they had a problem with alcohol and that they needed help was an eye-opener for many of the participants. To regard alcoholism as an illness also helped.

Another man expressed a sense of liberation and as if a stone fell from his chest when he started to talk about his problem. The tendency in the past, for many of them, had been to rationalize or suppress the problem which in turn had prevented them from taking any actions.

Some of them had sought help, on more than one occasion, but the problem had been that it was too short or that they lacked support from others.

Attitudes towards alcolock

In study 1 respondent´s attitudes towards alcolocks were also discussed. Most of them had a relatively positive attitude towards alcolocks even though they had certain reservations. This depended on how long it should remain fitted and the price. Some considered that alcolock devices should be fitted into all cars since they would then feel less exposed. The device which the respondents in the study had used was an alcolock which had been manufactured in Canada in the 1980s, and it was therefore not surprising that it was considered to be very complicated, unreliable and conspicuous. Since the cost of installing an alcolock device was high, several persons considered that the device should be linked to a person and that it should be easy to dismantle and to use in several vehicles. Due to the high cost, several of the respondents had also refrained completely. With respect to the risks associated with alcolock devices, several respondents considered that blowing the alcolock during the journey was associated with a large traffic safety risk. Some respondents considered that it was relatively easy to manipulate the device by letting somebody else blow, but others could nevertheless not imagine that anybody would manipulate the alcolock at all.

Some pointed out the importance of participating in the treatment program and were of the opinion that participating only in the alcolock program would not have the same positive effect. Several were convinced that they would not have arrived at the same insights without participation in the treatment program.

Conclusion

In this study twenty-six people who had been charged with drinking and driving was interviewed. The results showed that the great majority of the respondents had previously driven under the influence of alcohol and that they had problems with alcohol. A general view was that alcohol did not make them into a worse driver. Instead the main risk with drinking and driving was to be stopped by the police, although the risk of being discovered was considered to be rather small.

Their general perception of the social norms was one of disapproval although some of them believed that the behaviour was not that uncommon. However, after the event they felt a great sense of guilt and shame a feeling many times connected with being caught by the police and that they had to admit to themselves that they were not in control. Being charged with drinking and driving was also regarded as a greater offence than other traffic related offences.

With regard to sanctions the participants strongly agreed that losing the driver’s licence, would not have been sufficient in helping them to deal with their alcohol problems. What they needed was support and help which the treatment could offer. Before the treatment, many had denied that they had any problem with alcohol.

In the first study the respondents’ attitudes towards alcolocks were also discussed. In the main they were positive towards installing an alcolock in their car although they had certain reservations. The cost was for some too high which meant that they could not take part in the programme. The advantage with an alcolock was that they could carry on driving the car but they did not believe that it would help them with overcoming their problems. This would then be in accordance with Freeman et al. (2005) who pointed out that it is important to focus on the underlying issues that directly influence the behaviour such as the abuse of alcohol. This would also be in accordance with recent analyses, which have suggested that remedial interventions – especially those combining psychotherapy, education, and follow up – can reduce recidivism and crashes, even for relatively high risk drivers (Donovan, et al., 1985).

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Higher levels of hair EtG in patients with decreased kidney function.

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Abstract

Background
Hair levels of ethyl glucuronide (EtG) are often used in cases where driving qualifications are evaluated, as hair EtG levels are able to differentiate alcohol abstention from social or heavy drinking. Patients with decreased kidney function have delayed excretion of EtG, and increased incorporation into hair could be suspected.

Aim
The aim of this study was to compare hair EtG levels in patients with decreased kidney function to those seen in healthy volunteers.

Methods
19 renal disease patients were included. The levels of EtG in hair were adjusted to estimated daily intake of ethanol (EDI) and compared to 21 previously published healthy individuals. The preliminary results was published earlier this year, but in this publication for the ICADTS-conference 2013, we will in addition present data from a larger material from which data collection is currently taking place.

Results
The levels of hair EtG in the 19 patients ranged between < limit of detection (LOD) and 134 pg/mg, and the EDI ranged between 0.1 and 28 g. The levels of EtG in hair were significantly higher in the patients with decreased kidney function compared to healthy volunteers ($p=0.004$).

Discussion and conclusions
These preliminary results indicate that hair levels of EtG in a population of patients with decreased kidney function should be interpreted with caution. This should be remembered if this analysis is used to asses suitability to hold a driving license.

Introduction

Long-term alcohol use can be confirmed by EtG in hair. A cut-off value of 30 pg/mg in the proximal 3 cm hair segment has been suggested to detect a high daily intake of alcohol (above 60 g/day) (Potgieter, 2000) during the last three months (Alt, Janda, Seidl, & Wurst, 2000; Morini, Politi, & Polettini, 2009). So far, all published articles indicate that EtG in hair shows the best diagnostic sensitivity and specificity for detection of chronic heavy alcohol consumption compared to other traditional ethanol biomarkers.

Prolonged urinary detection times for EtG in patients with decreased kidney function has previously been published (Hoiseth, Nordal, Pettersen, & Morland, 2012). Renal excretion is the major elimination route for EtG. This implies that higher blood concentrations of EtG could be seen in this patient population compared to healthy volunteers, after an identical intake of alcohol. Incorporation of EtG into hair roots may increase due to the increased blood levels of EtG. The aim of this study was therefore to investigate if hair levels of EtG in patients with decreased kidney function differed from those seen in healthy volunteers.

Materials and methods

The preliminary results of the first 12 patients were published earlier this year (Hoiseth, Morini, Ganss, Nordal, & Morland, 2013). The data collection is currently taking place and we will in this publication present additionally 7 patients, which will give a total of 19 patients with decreased kidney function.

Study protocol

Non-dialyzed renal disease patients were recruited from the renal failure clinic at Akershus University Hospital, Lørenskog, Norway. Inclusion criteria were serum creatinine value >90 μmol/L in women and >100 μmol/L in men, estimated glomerulus filtration rate (GFR) <60 mL/min/1.73 m^2 (automatically calculated from creatinine using the MDRD formula including age and sex) (Rule, 2007) and a diagnosis of decreased kidney function in the patient's journal. Only patients having a moderate use of alcohol were included in our study which was approved by the National Committee for Research Ethics in Norway, the Norwegian directorate of health and the local ethics committee at Akershus University Hospital. All patients signed informed consent before attending the study.

An estimated daily intake of ethanol (EDI) (calculated on the basis of the time-line follow-back test) for the last three months was obtained by interviewing the patients carefully about type of beverage and amount consumed on a typical day. Information was also received from the patients' medical record. This included diagnoses, serum creatinine value and the estimated GFR, as objective measurements of the individual renal function. Values of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and gamma-glutamyl transferase (GGT), were also collected, as objective indicatorsof possible alcohol overconsumption. Hair was collected from each patient by cutting a hair specimen as close as possible to the skin. The 3 cm proximal hair segment, roughly representing the last three months, was submitted for EtG analysis.

The results from these renal disease patients was compared to 21 previously published healthy volunteers (Politi, Morini, Leone, & Polettini, 2006).

Analytical methods

EtG in hair was determined using a previously published method (Morini, Politi, Groppi, Stramesi, & Polettini, 2006). The samples were analysed in LC-MS/MS system. A calibration curve ranging from 3 to 200 pg/mg was used for quantification purposes. The limit of detection (LOD) was 2 pg/mg and the lower limit of quantification was 3 pg/mg.

Statistics

Differences between hair levels of EtG in patients and healthy volunteers were studied using a multiple linear regression analysis with the EDI as a covariate. The standardized β-values with p-values for a difference between groups (adjusted for doses) are given. A p-value below 0.05 was considered significant. Correlation between hair levels of EtG and GFR or serum creatinine was assessed using Spearman's non-parametric rank correlation test.

Results and discussion

19 patients (15 men and 4 women) were included in the present study. The median age was 60 years (range 39-84) and median body mass index was 26.4 kg/m^2 (range 18.9-31.1). All three inclusion criteria for decreased kidney function were present in all patients. The median serum creatinine value was 257 µmol/L (range 130-670). Median estimated GFR was 22.0 mL/min/1.73 m^2 (range 8.0-54.0) and all subjects had a diagnosis of decreased renal function in their medical record. All subjects had ALT, AST and GGT within the normal range (≤50 U/L for ALT and AST, ≤60 U/L for GGT) (Klauke et al. 1993; Rustad et al. 2004; Szasz 1974).

The levels of hair EtG in the 19 patients ranged between < LOD and 134 pg/mg, and EDI ranged between 0.1 and 28 g. This is shown in table 1. In the previously published 21 (12 men and 9 women, median age 32 (range 25-54)) healthy volunteers used for comparison, the hair EtG ranged between < LOD and 35.4 pg/mg and EDI ranged between 2 and 64 g (Politi et al. 2006). The levels of hair EtG (corrected for EDI) in the present study (n=19) were significantly higher than for previously published healthy volunteers (n=21) (β=0.540, p=0.004). This is shown in Fig. 1.

In the patients with decreased kidney function (n=19), there was a significant correlation between the level of EtG in hair (corrected for EDI) and the GFR (Spearman's ρ= - 0.545, p=0.016). The correlation between hair EtG (corrected for EDI) and serum creatinine was also statistically significant (Spearman's ρ=0.530, p=0.019).

Patient number	**Hair EtG (pg/mg)**	**EDI (g/day)**	**GFR (mL/min/1.73**	**Serum creatinine**
1	< LOD	0.4	44.3	141
2	12.1	0.8	22.0	192
3	< LOD	0.6	32.4	186
4	< LOD	2.4	18.7	286
5	54.5	7	23.6	178
6	69.6	5.6	8.0	670
7	< LOD	1.4	10.5	390
8	< LOD	0.1	30.4	148
9	< LOD	0.4	39.9	151
10	< LOD	1.6	54.0	130
11	11,6	10	28.0	250
12	134	12	10,3	500
13	< LOD	1.2	15.0	348
14	20.7	1.2	11.2	470
15	26.1	20.6	25.9	226
16	13.7	4.8	16.3	337
17	9.6	0.8	12.3	410
18	31.3	28	11.9	440
19	13.3	10.9	22.2	257

Table 1. Individual data of hair ethyl glucuronide (EtG) and estimated daily intake of ethanol (EDI) last 3 months in 19 patients with renal disease. Glomerulus filtration rate (GFR) and serum creatinine are also shown. Limit of detection (LOD) = 2 pg/mg.

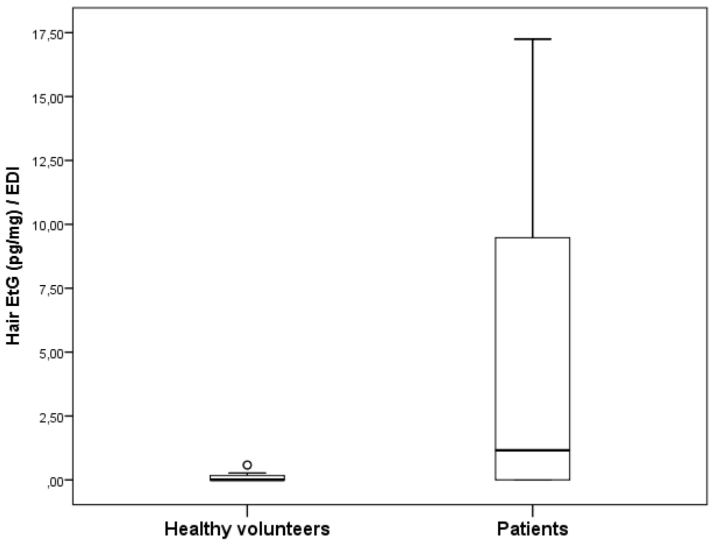

Figure 1. Levels of ethyl glucuronide (EtG) in hair corrected for estimated daily intake of ethanol (EDI) in patients with decreased kidney function compared to healthy volunteers. The box length is the interquartile range of Hair EtG / EDI. The line across the inside of the box represents the median value.

This study suggests that among social drinkers, levels of EtG in hair are higher in patients with decreased kidney function compared to healthy volunteers. The relation between hair EtG level and GFR or serum creatinine also strengthen this assumption. The possibility of false positive diagnosis of heavy drinking among renal disease patients must be taken into consideration when hair EtG is used to assess suitability to hold a driving license.

These results are based on a small number of patients and must be considered to be preliminary. Further studies should be undertaken to gain more insight of interpretation of hair EtG levels.

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Substance use and associated diseases among injured persons

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Abstract

Background

Alcohol is a prominent factor in the need for emergency department care worldwide. Similarly, chronic health conditions are taken as risk factors for injury as well as the consequences of the injury. Very few studies have noted about diseases among injured persons.

Aims

To find out the use of alcohol among injured persons and to explore the associated diseases among injured persons.

Methods

In this study 10% of the households of Dharan, Nepal, i.e. 1398 households were selected as the sample size. A systematic random sampling was used to select the 10% household from each ward. A pre-tested questionnaire was used to collect demographic information and information related to injuries to the persons suffered from injuries, alcohol intake prior to injury and whether they suffered from any chronic diseases or not.

Results

Total of 1388 households having 7063 persons were interviewed, where 299 (4.2%) persons were found to be injured. Among injured persons 20.4% of them used to take alcohol and 0.7% were illicit drug consumers. It was noted that 5.4% consumed alcohol prior to the injury. About 8% injured persons were hypertensive and 7.7% of them suffered from visual problems. About 10% of the injured persons were suffering from physical disability.

Discussion and Conclusion

Consumption of alcohol is prevalent among injured persons in Dharan. Chronic health problems like hypertension, visual impairment and physical disability are common among the injured ones.

Introduction:

Alcohol can cause impairment in judgment, balance and motor coordination that contributes to high incidence and severity of injuries. The early effects of alcohol therefore are on the brain or central nervous system and are felt first on the higher intellectual functions like thinking, judgment, reasoning, reflex activity and an activity called response modulation, ability to control our reactions. Alcohol is responsible for approximately half of all trauma deaths and nonfatal injuries in the United States. Forty percent of motor vehicle crash deaths involve alcohol drinking and 40 percent of pedestrians killed had been drinking. The contributory role of alcohol in intentional trauma deaths is just as bad. [1,2,3,4]

Although alcohol consumption has been found to be a major risk factor for both intentional and unintentional injuries in emergency department settings, few studies have evaluated alcohol's contribution to the relative risk of nonfatal injury[5,6,7].

Available evidence suggests that the medical condition of drivers is an important factor when assessing fitness to drive and the ability drive safely[8].In a Norwegian retrospective study based on 230 forensic reports of drivers involved in fatal car accidents, it was found that as many as 27 drivers (12%) died from natural causes, the main cause being acute cardiovascular disease. In an additional 17 cases (7%) serious cardiac disease, CNS pathology or diabetic complications also contributed significantly[9].

Objectives:

- To find out the use of alcohol among injured persons
- To explore the associated diseases among injured persons

Methodology:

This Community based cross-sectional study was conducted during 2004 to 2005 in Dharan municipality, eastern region of Nepal. In this study 10% of the households of Dharan i.e. 1398 households were selected for the study sample. A systematic random sampling was used to select the 10% household from each ward. A detailed questionnaire was used to collect demographic information of all members of each households and information related to injuries to the persons suffered from injuries. The injured persons were asked regarding intake of alcohol prior to occurrence of injury and whether injured persons suffer from any chronic diseases like epilepsy, hypertension, diabetics and heard of hearing, psychiatric disorders etc. We categorized severity of injury as 'minor' if resulting in less than 30 days of lost of activity and 'major' if resulting in 30 or more days of lost activity[10]. The collected data was entered in Microsoft Excel and analysis was done by calculating percentage and proportions.

Results

Of the total surveyed 7063 population from 1398 households 299 injured persons were reported during survey.

Table 1. Substance use among Injured Persons*

Substance use	Type of injury					
	Minor(n=250)		Major(n=49)		Both (n=299)	
	No.	%	No.	%	No.	%
Smoking	44	17.6	8	16.3	52	17.4
Chewing of Tobacco	25	10.0	10	20.4	35	11.7
Consumption of alcohol	49	19.6	12	24.5	61	20.4
Consumption of Illicit drugs	1	0.4	1	1.0	2	0.2

(Multiple responses)*

Among both injury category 20.4% were alcohol consumers. Likewise, smokers, Tobacco chewers and illicit drug consumers were 17.4%, 11.7% and 0.7% respectively (Table 1).

Table 2. Consumption of Alcohol by Injured persons prior to the occurrence of injury

Alcohol Consumption	Type of injury					
	Minor		Major		Both	
	No.	%	No.	%	No.	%
Yes	15	6.0	1	2.0	16	5.4
No	235	94.0	48	98.0	283	94.6
Total	250	100	49	100	299	100

Among both injury categories 94.6% had not consumed alcohol prior to occurrence of injury. Only 5.4% had consumed alcohol prior to occurrence of injury.

Table 3. History of associated diseases among injured persons*

Disease	Type of injury					
	Minor		Major		Both	
	No.	%	No.	%	No.	%
Hypertension	22	8.8	3	6.1	25	8.4
Visual Problem	21	8.4	2	4.1	23	7.7
Diabetes	10	4.0	0	0	10	3.3
Physical Disability	6	2.5	5	10.4	11	3.8
Hard of Hearing	4	1.6	2	4.1	6	2.0
Other Problems**	2	0.8	2	4.0	4	1.3

*(*Multiple responses)* *(**Others: Epilepsy, Psychiatric problems)*

Among both injury groups, 8.4% of the injured persons had history of hypertension (Table 3), followed by visual problem (7.7%) and physical disability (3.8%). Similarly the history of diabetes, hard of hearing and other problems (like epilepsy and psychiatric problems) were present in 3.3%, 2.0% and 1.3% of the cases respectively.

Discussion

Alcohol and tobacco use in Dharan has been studied by many researchers. For example, alcohol use among women of Dharan was studied by Niraula SR et al[11] and found 16.8% of women aged 15 years or above were alcohol drinkers. In comparison to this, alcohol users were slightly high in our finding. In another study done by Niraula SR et al[12] in 2001, prevalence of smoking among females of Dharan aged more than 15 years was 13.0% while the prevalence of smokeless tobacco was 14.1% which is quite comparable to our findings. Similarly, Jha N and Subba B[13] had done a study on tobacco use among college students in Dharan in 1993 and found that 24.8% of them were current users of tobacco. In contrast smokers and smokeless tobacco users were found to be less in our study. Sixteen persons had history of alcohol consumption prior to injury (Table 2). The role of alcohol in impairing driving ability is well documented. Also the impairment increases as the blood alcohol level rises. In addition, the risk of accidents is higher in youngsters and elderly people for the same blood alcohol levels. Study done by Jha N et al [14] in South India found that 14.9% of drivers were found to have consumed alcohol prior to the accident. Comparatively, the prevalence of alcohol use prior to injury in our study was 5.4% which is less than the south Indian study. The difference can be explained by the fact that the south Indian study included only the RTAs in which accidents after drinking is quite common. Hospital based study done in Mexico City by G. Borges[15] found that the estimated relative risk of injury for patients who reported having consumed alcohol within 6 hours prior to injury was 3.97 (95% CI: 2.88, 5.48). This increase in the relative risk was concentrated within the first 2 hours after drinking; there was a positive association of increasing risk with increasing number of drinks consumed.

Our study revealed that among both injury categories 8.4% as having the history of hypertension and 7.7% suffered from visual problems (Table 3) and 10.4% of the major injures persons having the history of physical disability. As we know that diseases mentioned above could be the precipitating factors in causing different types of injuries. Study done by Charlton et al[16] entitle “Influence of chronic illness on crash involvement of motor vehicle drivers” reported that eight conditions were found to have at least a moderately elevated risk of crash involvement (relative risk greater than 2.0) compared with their relevant control group. These were alcohol abuse and dependence, dementia, epilepsy, multiple sclerosis, psychiatric disorders (considered as a group), schizophrenia, sleep apnoea, and cataracts. Similarly TOI report carried out by Truls Vaa[17] in meta analysis entitled “Impairments, diseases, age and their relative risks of accidents involvement, shows that all main categories of impairment except renal disorders were associated with a statistical significant increase in the risk of being involved in a road accident. Alcoholism, neurological diseases, mental disorders and drugs and medicines all belong to the high-risk group, while vision impairment, arthritis, locomotors disability, hearing impairment and cardiovascular diseases all belong to the low-risk group. Diabetes mellitus lay in between the high-risk and the low-risk group with a relative risk of 1.56. However, in our study context much detailed studies are required to establish any relationship between injuries and the above-mentioned diseases.

Conclusion

Consumption of alcohol is prevalent among injured persons in Dharan. Chronic health problems like hypertension, visual impairment and physical disability are common among the injured ones. Assessment of consequences of chronic illness and chronic consequences of injuries is required. It is always needed to prevent risky human behavior and morbidity associated with injury.

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Associations between substance use among car and van drivers in Norway and fatal injury in road traffic accidents

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Background
The prevalence of drunk driving is low in Norway; only about 0.2% of car drivers have blood alcohol concentrations (BACs) above the legal limit of 0.02 g/dl. The prevalence of driving with concentrations of psychoactive drugs in blood above the legislative limits is estimated to be 1-2%. However, alcohol is still the most commonly found substance in blood samples from drivers killed in traffic crashes.

Aims
The aim of this study was to calculate the odds ratio (OR) for fatal injury in road traffic accidents after using alcohol or drugs by using a case-control design.

Methods
The 'Cases' were 508 drivers killed in road traffic accidents in 2003-10 and the 'Controls' were 9 261 random drivers in normal traffic. Blood samples from 'Cases' and oral fluid samples from 'Controls' were analysed for alcohol and 17 drugs.

Results
The OR for being killed in a traffic crash with blood alcohol concentration above the legal limit of 0.02 g/dl and no drug detection was 124.6 (95% CI 69.1-224.9); the OR after using alcohol in combination with drugs 602.2 (95% CI 76.1-4764.0). The OR after using only one psychoactive medicinal drug was 6.0 (95% CI 3.7-9.8); no significant ORs were found for the specific use of only zopiclone or THC.

Discussion and conclusions
The OR for alcohol was similar to ORs found in other studies in Norway and neighbouring countries, but very much higher than the OR found in studies in Central and Southern Europe and North America. ORs for other substances were more similar to other studies. It is likely that the observed high ORs, particularly for alcohol, are not only related to the risk posed by the substance alone, but confounding factors and study design are also important.

Introduction

The prevalence of driving with blood alcohol concentrations (BACs) above the legal limit of 0.02 g/dl is low in Norway; only 0.2% of motor vehicle drivers in random traffic have BACs above this limit (Gjerde et al., 2013a). However, a large proportion of drivers killed in road traffic accidents in Norway have high BACs. The prevalence of driving with drug concentrations above the legislative limits is about 1-2% (Gjerde et al., 2013a).

Case-control studies are by many researchers regarded as the best method for studying the associations between the use of psychoactive substances and involvement in road traffic accidents (Houwing et al., 2012). In this type of study, the OR for involvement in traffic crash is usually calculated; in some cases the relative risk (RR). The OR and the RR are approximately equal if the outcome is rare, which is the case for serious traffic accidents. Several case-control studies have been performed for alcohol, e. g. the Grand Rapids study (Borkenstein et al., 1974) and the Long Beach/Fort Lauderdale study (Blomberg et al., 2009).

Some studies have also included illegal and medicinal drugs; a recent large study was organized by the DRUID Project (Driving under the Influence of Drugs, Alcohol and Medicines) and included 3610 'Cases' (2492 injured and 1118 killed drivers) and 48 542 'Controls' (Hels et al., 2011).

The aim of this study was to use data on drivers killed in road traffic crashes in Norway and data from the latest Norwegian roadside survey, which was a part of the DRUID Project, to calculate ORs for involvement in fatal road accidents after using alcohol or drugs.

Methods

In most fatal road traffic accidents, the police requests sampling of blood from the drivers for analysis of alcohol and drugs. The samples are either taken shortly after the accident or at legal autopsy. All samples of the first type and about 90% of legal autopsy samples are analysed by the Norwegian Institute of Public Health (NIPH), and results are recorded in the Forensic Toxicology Database at NIPH. The police also submits additional data on persons injured or killed in road traffic accidents to Statistics Norway. These data are entered into the Norwegian Road Accident Registry. A new dataset was generated by Statistics Norway by coupling those two databases, selecting drivers of cars and vans who had been killed in road traffic accidents in Norway from January 2003 to December 2010 in order to obtain a large number of 'Cases'. We excluded drivers who died more than one day after the accident.

'Controls' were selected in a roadside survey from April 2008 to March 2009 using a stratified multi-stage cluster sampling procedure. In the first stage, representative police districts were chosen. In the second stage, random road sites and time intervals were selected. The third stage consisted of randomly stopping drivers. The data collection was carried out in collaboration with the National Mobile Police Service. Study team members told the drivers that this study was voluntary and anonymous and asked for sample of oral fluid for alcohol and drug testing. After an informed consent was obtained, a sample of oral fluid was taken using Statsure Saliva Sampler™ (Statsure Diagnostic Systems, Framingham MA, USA).

Samples of blood and oral fluid were analysed for alcohol and a number of illegal drugs and psychoactive medicinal drugs (see Table 1). Equivalent cut-off concentrations were used for blood and oral fluid. When using equivalent cut-off concentrations, the prevalence of positive drug findings in oral fluid will be equal to the prevalence in blood samples and the detection time in blood and oral fluid will be the same (Gjerde & Verstraete, 2011; Verstraete et al., 2011). The following covariates were included in the logistic regression model: gender, age group (six age intervals), geographical region (south-east, south-west or middle/north), type of road (urban or rural), season of the year (spring, summer, fall or winter), and eight time periods of the week. More information about selection of 'Cases', 'Controls', sampling and analysis has been published earlier (Gjerde et al., 2013b).

Results

During 2003-10, 830 drivers of cars and vans were killed in road traffic accidents in Norway. Blood samples of 508 of those drivers (61%) were sent to NIPH for analysis of alcohol or drugs and thus included in this study as 'Cases'. Complete analysis of all the 18 included substances was performed for 432 'Cases'; all the remaining ones were analysed for alcohol, and most of them also for the most relevant drugs. The reason for incomplete testing was most often that high BACs were found and the police did not ask for further testing or that a limited amount of blood was available for analysis. The 'Controls' consisted of 9 261 drivers in normal road traffic (participation rate 94%); complete analysis was performed for 9 210 of them (99.4%); the remaining were analysed for either alcohol or drugs due to small sample volume.

Table 1. Cut-off concentrations in blood and oral fluid and crude prevalence of substances in blood samples from 'Cases' and oral fluid samples from 'Controls'.

Substance	Cut-off (ng/ml)		Crude prevalence (%)[c]	
	Whole blood (for 'Cases')	Oral fluid (for 'Controls')	'Cases'	'Controls'
Alcohol	0.02 g/dl	0.016 g/dl	25.59	0.26
Medicinal drugs	–	–	14.8	1.27
Alprazolam	3[a]	1.1	1.18	0.04
Clonazepam	1.3[a,b]	0.23	2.17	0.12
Codeine	100	680	0.20	0.04
Diazepam	57[a]	2.2	5.51	0.40
Flunitrazepam	1.6[a]	0.23	0.59	0.03
Methadone	25[a]	54	0.98	0.03
Morphine	9[a]	86	1.38	0.01
Nitrazepam	17[a]	1.5	0.48	0.11
Nordiazepam	100	5.4	3.54	0.23
Oxazepam	172[a]	45	3.14	0.05
Zolpidem	31[a]	8.5	0.39	0.00
Zopiclone	12[a]	30	3.15	0.59
Illegal drugs	-	–	12.8	0.73
Amphetamine	41[a]	740	6.88	0.11
Cocaine	24[a]	490	0.20	0.03
MDMA	48[a]	650	0.39	0.00
Methamphetamine	45[a]	930	4.72	0.15
THC	1.3[a]	39	6.10	0.58

[a]Legislative limits in Norway from February 2012. [b]Some blood samples were analysed with an analytical method with higher cutoff. [c]Includes both single and combined use of a substance.

Crude analytical results are presented in Table 1 showing that alcohol was the most frequently found single substance in samples from 'Cases', followed by amphetamine, THC, and diazepam. During the study period there was a decline in amphetamine use and an increase for methamphetamine and a slight shift between different benzodiazepines. Among 'Controls', the most frequently found substances were zopiclone, THC, diazepam and alcohol. ORs for involvement in a fatal traffic crash are presented in Table 2 and shows that the highest OR was observed for combination of alcohol with drugs, followed by alcohol alone.

Discussion and conclusions

The ORs for drugs are similar to those found in previous Norwegian and Finnish studies (Gjerde et al., 2011; Lillsunde et al., 2012) and in the DRUID Project (Hels et al., 2011). ORs for alcohol of 68.6 and 160 have been calculated in previous Norwegian studies (Glad, 1985; Gjerde et al., 2011) and an OR of 44.2 was found in a Finnish study (Lillsunde et al., 2012). No similar case-control study has been performed in Sweden. However, based on published data on the prevalence of alcohol above the legal limit among drivers killed in traffic crashes (Jones et al., 2009) and results from police breath testing campaigns (TISPOL, 2009), a crude OR of 64.3 was calculated.

Table 2. Number of positive findings in samples from 508 'Cases' and 9 261 'Controls' and adjusted odds ratios for involvement in fatal road traffic accident.

Substance(s)	No. of positive 'Cases'/'Controls'	Adjusted OR[b]	95% Confidence interval
Alcohol	130/24	199.5	112.6-353.2
Alcohol only[a]	97/23	124.6	69.1-224.9
Alcohol+drug(s)	33/1	602.2	76.1-4764.0
Psychoactive medicinal drugs	75/118	16.1	11.1-23.3
Only a single medicinal drug[a]	29/108	6.0	3.7-9.8
Benzodiazepines	60/64	25.5	16.4-39.8
Only one single benzodiazepine[a]	17/49	8.5	4.4-16.3
Zopiclone	16/55	5.8	3.0-11.3
Only zopiclone[a]	6/52	2.1	0.8-5.4
Illegal drug(s)	65/68	21.4	13.8-33.2
THC	31/54	8.9	5.2-15.4
Only THC[a]	7/48	1.9	0.8-4.6
Amphetamines	45/17	76.9	38.7-152.9
Only amphetamines[a]	10/8	41.6	12.6-137.1

OR = odds ratio. [a]No other substance was detected. [b]Adjusted for time period, region, season, road type, gender, and age group. 'Controls' with unknown age or gender were excluded from the analysis.

The reported ORs for involvement in a fatal crash in Portugal and Canada after using alcohol were 12.1 and 14.1, respectively (Hels et al., 2011; Brault et al., 2004). When using old data from the USA to calculate crude ORs, values of 6.0 and 13.4 may be obtained (Perrine et al., 1971; McCarroll & Haddon, Jr., 1962). Better estimations of the relative risk for involvement in fatal crash in relation to BAC have been published more recently (Zador et al., 2000; Voas et al., 2012), but those studies do not include data on the risk associated alcohol in total. It seems that high ORs were found in countries with low prevalence of BAC above 0.05 g/dl among drivers in normal road traffic, such as Norway, Sweden and Finland (prevalence ≤ 0.2%); whereas low ORs are observed in countries with prevalence of more than 1%.

Some factors affecting the calculated odds ratio

The ORs are related to the concentration of alcohol or drugs and whether only single use or any use (including any combination with other psychoactive substances) of a substance is included. The participation rate is important both for 'Cases' and 'Controls'. If the participation rate is low for 'Controls', we may expect that some of them refused to participate because they had used a psychoactive substance, so the prevalence of substances might be artificially low. If the inclusion rate is low for 'Cases' because the police selected which drivers to investigate for alcohol or drugs, the non-participants may have lower prevalence of alcohol or drug use. In both cases, the calculated OR will be too high.

If including 'Cases' killed in multiple-vehicle accidents, there will be a dilution of the OR. This dilution will occur because some sober drivers who collide with drunk or drugged drivers may die in the crash, and those will be counted as 'Negative Cases' even though it was a alcohol or drug related accident. This dilution will be larger in populations were drunk or drugged driving is more common (Gjerde et al., 2013c).

Finally, important confounding factors are pronounced risk taking behaviour, sensation seeking, impulsivity and other personality factors that are associated with alcohol or drug use and risk taking while driving a motor vehicle. The importance of these confounding factors may differ between countries. In Norway, the vast majority of arrested drunk and drugged drivers have criminal records or are alcoholics or drug abusers. This may be related to the fact that it is socially not accepted to drive under the influence of alcohol or drugs (Assum, 2010), and accordingly only about 0.2% of the drivers have BACs above 0.02 g/dl.

The variation in ORs calculated in different countries may be related to a combination of a number of factors; some important ones are bias in selection of 'Cases', the refusal rate among 'Controls', the prevalence of drivers with pronounced risk-taking behaviour, and the inclusion on non-culpable drivers among 'Cases'.

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The rehabilitation of drivers who have committed repeated or serious driving offences[1]

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Abstract

Background
In Germany, license restoration after serious or repeated offences requires a positive Medical Psychological Assessment (MPA, a test to determine the driver's aptitude). Fulfilling the conditions necessary for a positive MPA often takes longer than the driving ban period.

Aim
The aim of the study was to analyze the key aspects of successful rehabilitation after repeated or serious driving offences.

Methods
After participating in the MPA, 1,631 subjects filled in a questionnaire about rehabilitation efforts in order to regain their driver aptitude. The selection of relevant information to be given was made based upon prior own research, interviews with problem drivers and the diagnostic criteria of MPA. Participants were asked when and from whom they got certain information, and how relevant this information was for their success.

Results
Around half (52.6 per cent) of the participants felt themselves to be optimally informed about the rehabilitation process. The other half (47.4%) judged the level of information to be less than satisfactory.
The group of offenders who did not partake in counseling prior to the MPA achieved a successful result only about half as often (37.1%) as those who did (70%) and are around three times more likely to have additional courses imposed upon them (21%).
If offenders received crucial and relevant information at an early stage, it emerged that 62.4% of these individuals attained a positive evaluation at the first attempt (regardless of having attended any training courses). The success rate for the first attempt rose to 81% for those cases where offenders were well informed at an early stage and in addition participated in training measures prior to their first MPA.

Discussion and conclusions
The results clearly indicate that the provision of relevant information at an early stage combined with counseling has a beneficial influence on success rates for the rehabilitation process (an increase from 37.1% to 81%). On the basis of these results, we recommend the introduction of an obligatory diagnostic procedure with a status assessment, counseling and the development of an individual program of measures by the start of a driving ban at the latest.

[1] The study was founded by the German Federal Highway Research Institute (BAST)

Introduction

In Germany, license restoration after serious or repeated offences requires a positive Medical Psychological Assessment (MPA, a test to determine the driver's aptitude). Without verifying driver's aptitude by a positive MPU, drivers with serious or repeated offences will not getting back their license by the traffic authority. Fulfilling the conditions necessary for a positive MPA often takes longer than the driving ban period. Because the MPA is a standard in the German system of license restoration, the result of the MPA (positive, negative or the mandatory attendance in a training course to restore the driver's aptitude) could be used as a good measure to determine whether the rehabilitation process is effective or not and what the key aspects of successful rehabilitation are.

Aim

The aim of the study was to find out the key aspects of successful rehabilitation after repeated or serious driving offences.

Methods

It was intended to find out the key aspects of successful rehabilitation by analyzing structured individual self-descriptions of rehabilitation efforts of the offenders. The selection of relevant information to be given was made based upon prior own research (Glitsch et al., 2006, Klipp et. al, 2007) interviews with problem drivers and the diagnostic criteria of MPA (German Highway Research Institute (BAST), 2000). Participants were asked when and from whom they got certain information, and how relevant this information was for their success.
For better understanding a few Item examples are given.
Source of information: From where or from whom did you receive the crucial helpful information in the process of getting your driving license back? *Time of information*: When did you get this decisive information? *Level of information:* How well informed did you feel in the process of getting your driving license back? *Relevance/helpfulness of information*: Which were the most important/crucial pieces of information for you? *Participation in counseling:* Have you taken part in a support program since the last withdrawal of your license? *Controllability I* (Perceived influence on the outcome of the MPA): How do you assess your influence on the MPU result? *Controllability II* (Perceived transparency of the criteria of MPA): How comprehensible do you consider the MPU assessment to be? *Controllability III* (Transparency of the whole procedure of the restoration of driver's aptitude and license): In your opinion, is the process from the point of withdrawal of the license to its return optimally organized and transparent? *Number of attempts to get a positive Medical Psychological Assessment:* Since your license was last withdrawn, how many times did you attend a medical-psychological examination? *Success in Medical Psychological Assessment:* What is the MPU result? *Date of license restoration:* When did you get your driving license back?

Hypothesis

1. The earlier the person got the information which was relevant and crucial for them, the earlier they got their permission to drive reinstated.

2. Those individuals who attended a consultation before the first MPA more frequently received a positive report than those individuals who did not take advice.

3. A successful assessment is correlated with the earliness of the receipt of relevant and crucial information, having access to information, taking up opportunities to gain advice and different forms of the perception of controllability.

Procedure

After participating in the MPA, 1,631 subjects throughout the whole German Federal states filled in a questionnaire about rehabilitation efforts which was send by the federal motor transport authority.

Results

The presentation of the results starts with descriptive analysis of the overall population. After that data about sub-groups and hypothesis testing will be shown.

Level of Information

Data showed that around half (52.6%) of the MPA participants felt sufficiently to optimally informed about the rehabilitation process. The other half (47.4%) judged the level of information to be less than satisfactory (see Fig. 1).

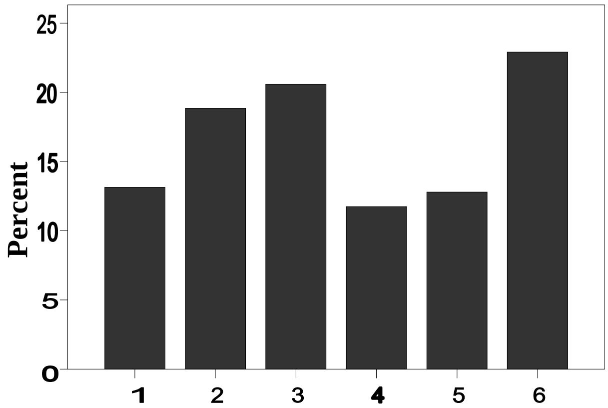


Fig. 1: Level of information (n= 1,622; 1 = optimal to 6 = poorly informed)

However, the majority of the MPA candidates questioned stated that they had received important information on fulfilling the conditions necessary for the restoration of their driving license either too late or only after considerable research, or that they had not received this information at all (see Fig. 2).

Information about…

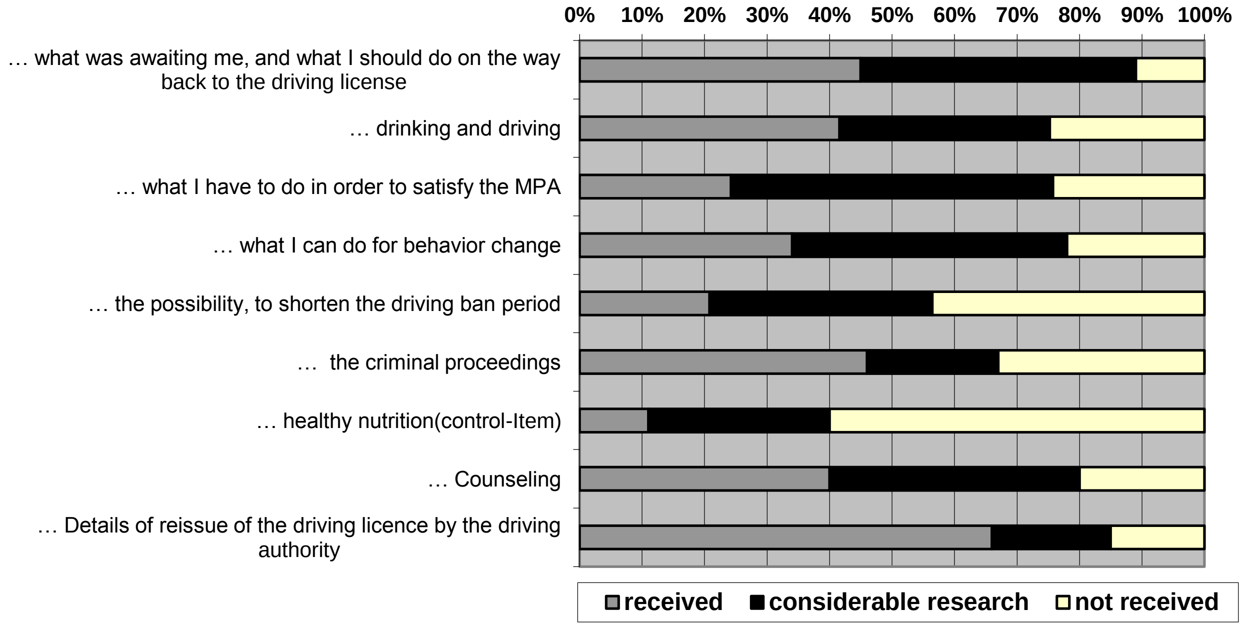


Fig. 2: Information research of MPA candidates

Testing the first hypothesis

The correlation between time of achieved crucial information after license withdrawal and time of being without driving license was $r = .41$ ($p < .001$). The later drivers got crucial information, the longer was the time without driving license.

Testing the second hypothesis

The Chi^2 - Test of differences between groups with or without consultation or counseling indicates strong differences between the three groups of MPA outcome "positive", "negative" or "negative with mandatory training option" ($Chi^2 = 52, n = 1,004$, $p < .001$, $df = 2$). The group differences are especially caused by the positive reported subjects.

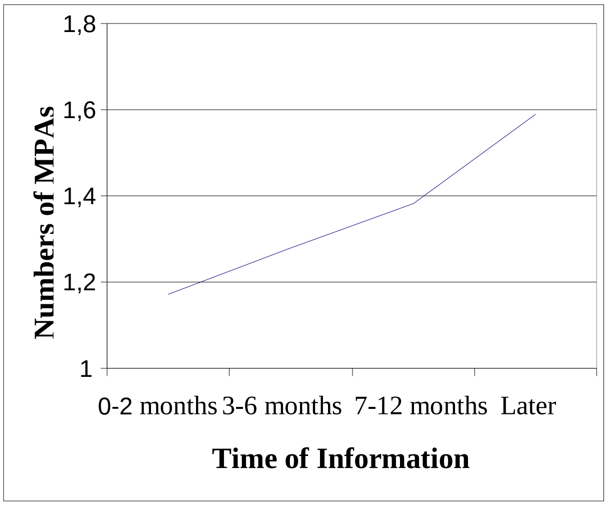
43.7% of first offenders took part – albeit it generally too late – in preparatory courses and counseling sessions before taking the MPA for the first time. Still, almost 70% of these individuals managed to receive a positive assessment. 7.6% are obliged to attend further courses. The group of offenders, who did not partake in counseling prior to the MPA, achieved a successful result only about half as often (37.1%), and are around three times more likely to have additional mandatory courses imposed upon them (21%).

If the group of offenders that received crucial and relevant information at an early stage and, in terms of the assessment guidelines, in good time is considered, it emerges that 62.4% of these individuals attained a positive evaluation at the first attempt (regardless of having attended any training courses). The success rate for the first attempt rose to 81% for those cases where offenders were well informed at an early stage and in addition participated in supportive measures prior to their first MPA. A further 6% were required to attend special mandatory courses.

Testing the third hypothesis

Strong effects appear between numbers of tries to get a positive MPA and time after license withdrawal until crucial information was obtained ($F(3, 1.134) = 11.22$, $p < .001$, see Fig 3).

Further on data show a strong association between level of information and transparency of the procedure (r = .59, p < .001, see Fig. 4).



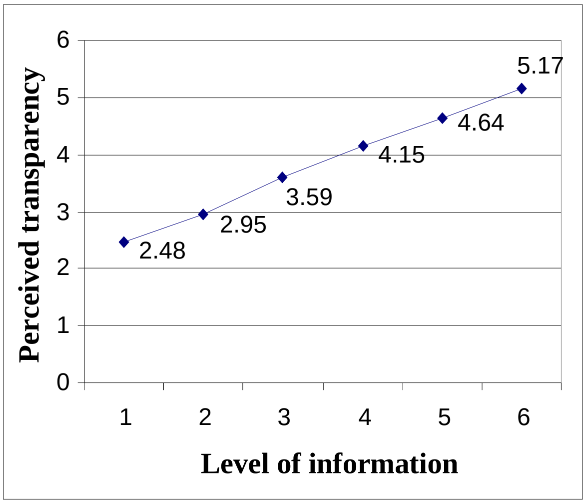


Fig. 3: MPAs and time of information

Fig. 4: Transparency and information

Transparency again increases controllability (r = .39, r = .29) and controllability at least is associated with an increasing success in restoration of driver's aptitude and driving license (r = .18 to .49; p < .001, see Fig. 5).

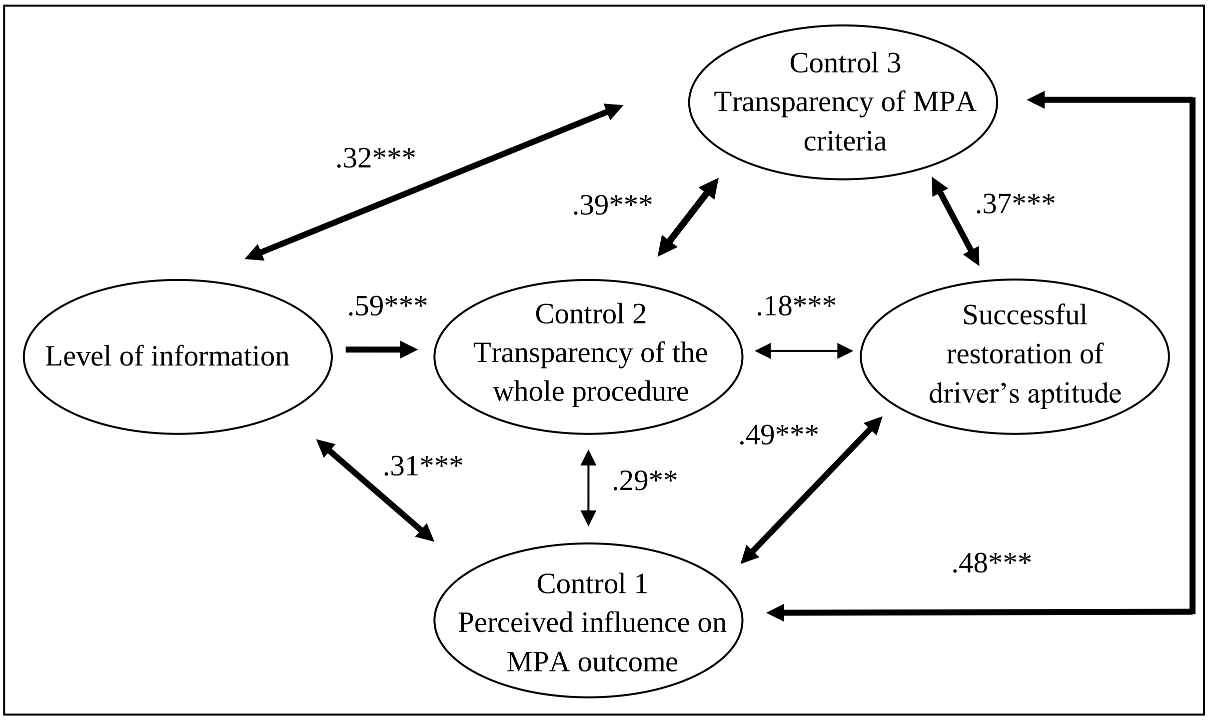


Fig. 5: Correlations between success in MPA, information and controllability

Discussion and Conclusion

The results clearly indicate that the provision of relevant information at an early stage combined with personalized counseling has a considerably beneficial influence on success rates for the rehabilitation process (an increase from 37.1% to 81%). Summarizing the key aspects of successful rehabilitation after repeated or serious driving, problem related and therefore relevant information at an early stage, transparency and controllability of the procedures and criteria for behavior changes in MPA are the key aspects of effective rehabilitation. These findings stand in accordance with our own past research and other findings based on the Theory of Health Action Process (HAPA, Renner & Schwarzer, 2001, Weinstein, 1998, Sheeran et al., 2005, Glitsch et al., 2006, Klipp et al., 2007).

Due to a lack of information and a lack of awareness of the real issue on the part of offenders, very few realize early enough that lasting changes in attitudes and behavior are necessary, if they are to be judged fit to drive. The inevitable consequence is considerable and, for the individuals affected, unexpected delays before their licenses can be restored.

On the basis of these results, we recommend the introduction of an obligatory diagnostic procedure with a status assessment, counseling and the development of an individual program of measures by the start of a driving ban at the latest. In this way, the phase of rehabilitation could be made more sustainable, efficient and comprehensible for the individual concerned. Such an approach is likely to have not only a positive effect on rates of re-offending but also to greatly increase the acceptance of official sanctions in general and the assessment of fitness to drive specifically.

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Death rates from alcohol-associated road traffic crashes among vulnerable road users in 5 Brazilian capital cities

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Abstract

Background
In Brazil, vulnerable road users (VRUs) including motorcyclists, pedestrians, and bicyclists, comprised more than half of all fatal road traffic injuries (RTIs) in 2010. Alcohol is a major risk factor for RTI, which is being targeted by the Global Road Safety Initiative (RS10) in five capitals. Few published studies on alcohol-associated RTI exist at the national level.

Aims
To analyze the prevalence of blood alcohol content among motorcyclists and pedestrians involved in fatal traffic crashes in five intervention Brazilian cities from 2000-2010: Palmas (North); Teresina (Northeast); Campo Grande (Midwest); Belo Horizonte (Southeast); and Curitiba (South).

Methods
Mortality rates were calculated based on Brazilian Ministry of Health data using ICD-10 codes, and disaggregated by sex, age, and city. The prevalence of alcohol associated RTI mortality was estimated after applying the proportion of deaths found to be positive for alcohol in another Brazilian capital.

Results
The prevalence of blood alcohol content among VRUs was highest in Palmas and lowest in Belo Horizonte; compare 10.07/100,000 inhabitants and 5.95/100,000 inhabitants respectively. The rates observed in Palmas and Teresina (9.91) are well above the national rate of 6.9/100,000 inhabitants. The blood alcohol content among VRUS in Curitiba and Campo Grande (both 6.61) are slightly below the five Brazilian capital cities rate.

Discussion and conclusions
Blood alcohol content in fatal traffic crashes among VRUs indicates the need for policy reform and renewed enforcement, including increased breath testing. Further analyses can help target interventions toward at-risk groups.

Introduction

Alcohol is a major factor in traffic crashes worldwide and the consequences are more likely to result in injuries and deaths than crashes when alcohol is not a factor. The National Highway Traffic Safety Administration (NHTSA) informed 41% of people fatally injured in traffic were in alcohol-related crashes (Hingson, 2003).

In Brazil the Road Traffic Accidents (RTA) has remained stable since the Brazilian Vehicle Code (BVC) in 1998 (around 20 deaths per 100,000 inhabitants). In Japan, Sweden and Canada the rates are around five to eight deaths per 100,000 (WHO, 2009).

Studies demonstrate the occurrence of collisions and pedestrian accidents are reflections of cities that have grown in a disorganized way, with no enough urban planning and education to the changes in attitudes and behaviors needed (HSE, 2005). Among the RTI victims, the more vulnerable are motorcyclists, cyclists and pedestrians.

That phenomenon is noticeably more intense in urban areas with higher population density (Minayo, 2003) which accumulate about 75% of total deaths caused by accidents and violence, which were the main causes responsible for Potential Years Loss of Life (PYLL).

When studying the health indicator PYLL, the concentration of deaths in early ages and young adults, and the high values that they have, makes these causes the most important groups within the external causes (Mello and Latorre, 1994). Thus, large losses are resulting from traffic accidents among young people in large urban centers of our country.

According to Rio de Janeiro Traffic Department 92% of deaths occur by human failings, of which 35% occur for alcohol abuse (DETRAN, 2004).

The Blood Alcohol Concentration (BAC) >0.6 grams of alcohol per liter of blood is considered a criminal offense in Brazil, since 2008 with the Zero Tolerance law. After that, few studies suggested the new law was effective in the months immediately after the law came into force, but it was true just for a limited period (Mello, 2009; Moura, 2009).

In Brazil, road traffic accidents will be the fourth leading cause of mortality according to the projected scenario for 2030 based on the Global Burden of Disease study prepared for the 1990 to 2020 period. These projections show perspectives on future trends based on the past, taking into account trends such as the ageing of the population, the epidemiological transition in the countries, economic and social development (Matters, 2005).

With the objective to better understand the present scenery, this study aimed to analyze the estimated prevalence of blood alcohol content among VRUs involved in fatal traffic crashes in five RS-10 Brazilian cities.

Methods

Mortality rates were calculated based on Brazilian Ministry of Health (MoH) public data using the WHO 10th Revision of the International Classification of Diseases and Related Health Problems (ICD-10) codes V01 to V89, and disaggregated by sex, age, and city.

Data on mortality represent all deaths occurred among the years 2000 to 2010, available from the Mortality Information System of MoH on the Informatics Department of Unified Health System (DATASUS) web site. The files from the period were downloaded and the registers related to the five cities were extracted using Brazilian public software from DATASUS.

The prevalence of alcohol associated RTI mortality was estimated by applying the prevalence of alcohol level based on data published of another Brazilian capital (Abreu et al, 2010). The proportion of 23.8 deaths with BAC above 0.1g/L was applied on the generated data, based on the specific study which results were obtained from the registers of blood alcohol rates of Legal Medicine Institute analyzes.

Results

The estimated BAC prevalence among RS-10 Brazilian cities traffic accidents death rate was the highest in Palmas (10.07/100,000 inhabitants) and the lowest in Belo Horizonte (5.95/100,000 inhabitants). The observed rates from Palmas and Teresina (9.91) are well above the national rate of 6.9/100,000 inhabitants. The blood alcohol content among Curitiba and Campo Grande (both 6.61) are slightly below the five Brazilian capital cities rate (see tab. 1). The Brazilian Capitals BAC average death rate is 21.0/100,000 inhabitants.

Table 1. Traffic Accidents Brazilian Average Death Rates, Road Safety 10 Cities, 2000-2010

Capital	Deaths	Population	Death Rates*	Alcohol deaths (estimated)	BAC death rates (estimated)*
Palmas	80	188,026	42.3	19	10.1
Teresina	323	774,874	41.6	77	9.9
Belo Horizonte	588	2,352,424	25.0	140	6.0
Curitiba	480	1,728,878	27.8	114	6.6
Campo Grande	203	731,408	27.7	48	6.6
Total RS-10	1,674	5,775,610	29.0	398	6.9

*per 100,000 inhabitants

Among the estimated BAC death rates from the five cities, when comparing the pedestrians and motorcyclists’ rates we found different indexes from general BAC death estimated rates.

Belo Horizonte presented the highest pedestrian BAC death estimated rate (2.3/100,000 inhabitants) but the lowest one for motorcyclists (0.9/100,000 inhabitants). Palmas and Teresina had the higher indexes for BAC deaths, 3.3 and 3.1/100,000 inhabitants respectively, related to motorcyclists, the only two very above the RS-10 average 1.4/100,000 inhabitants (see tab. 2). These results could be explained for the cities have the two largest motorcyclist fleets but as well they had the higher death proportions related to the fleet – Palmas 8.82 and Teresina 10.98. The average proportion among the Brazilian RS-10 cities is 6.98.

Table 2. VRU's Traffic Accidents Brazilian Average Rates , Road Safety 10 Cities, 2000-2010

Capital	Pedestrians			Motorcyclists		
	Deaths* rate	Alcohol deaths (% estimated)	BAC deaths rate* (estimated)	Deaths* rate	Alcohol deaths (% estimated)	BAC deaths rate* (estimated)
Palmas	7.2	3	1.7	13.9	6	3.3
Teresina	8.7	16	2.1	13.2	24	3.1
Belo Horizonte	9.7	54	2.3	3.7	21	0.9
Curitiba	9.0	37	2.1	4.9	20	1.2
Campo Grande	5.2	9	1.2	6.0	10	1.4
Total RS-10	8.7	119	2.1	6.0	82	1.4

*per 100,000 inhabitants

Considering the age risk factor, male pedestrians (30 to 49 years) are likely to death in traffic accidents than female (50 to 79 years) among all RS-10 Brazilian cities. The motorcyclists' fatal injuries traffic-related presented the same age group from 20 to 29 years for male and female groups in all analyzed cities.

Capitals from Southeast and South have the higher annual per capita gross national product (GNP) in 2010: Belo Horizonte (US$ 9,091) and Curitiba (US$ 12,360). In Belo Horizonte we observed the highest BAC deaths estimate rate for pedestrians and the lowest for motorcyclists. Curitiba presents the RS-10 Brazilian cities traffic accidents average rates for pedestrians and lowers BAC than the total RS-10 for motorcyclists. Campo Grande presents the same average for both estimative rates for pedestrians and motorcyclists. Palmas and Teresina are the highest BAC deaths estimated rate for motorcyclists, with the greater proportion of motorcycles related to the vehicles fleet.

Discussions and Conclusion

The blood alcohol testing was not actually done on traffic fatal victims in this study. Were used the results observed in another Brazilian capital study- Rio de Janeiro. But it is possible to estimate the presence of alcohol use by extrapolating data. The estimated results presented large rates of deaths by traffic accidents alcohol related mainly on North and Northeast Regions.

The results of the study demonstrate that a big sample was among the most vulnerable road user motorcyclists, and this may be explained by the higher proportions of motorcycles related to the vehicles fleet. Similar studies from WHO indicate in low-and middle-income countries in Africa, Asia and Latin America, the traffic accidents victims are mainly pedestrian, cyclists and other two-wheel vehicles. Among them, the low-income are the majority (Nantulya, 2002). Pedestrians are still at higher risk of death with increasing tendency (MoH, 2010).

Pedestrians impaired by alcohol influence the risk of a road traffic crash and also the severity and outcome of injuries that result from it, as fatal injuries. Many risk factors as lack of pedestrian facilities in roadway design and land-use planning, inadequate visibility, conflict at crossing points and many others (WHO, 2013) can be controlled by implementing pedestrian safety policies.

It is not possible to neglect the responsibility to implement actions to reduce alcohol-related accidents and then, save lives.

Although there is not a national study that provides BAC prevalence to all Brazilian Cities, the Road Safety 10 Cities Project is developing some interventions to obtain these indices. Then, it will be possible to identify if there is differences among cities and road users.

Anyway, we need to change the present scenario with so high traffic accidents death rates by improving the road conditions, educating people, enforce BAC limits and law enforcement. Besides that it is necessary to integrate the infor mation systems among traffic agencies, health, security and forensics for achieving a quality database. This would allow the definition for effective public policies and the evidence-based decision making to target interventions toward at-risk groups.

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Traffic accident risk associated with the prescription of drugs: a review of seven Norwegian registry-based cohort studies

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Abstract

Background

There is limited information about traffic accident risk associated with using medicinal drugs. We aimed to summarize seven Norwegian studies about the traffic accident risk after dispensing prescribed drugs. Different medicines were studied, including those where an increased traffic accident risk would be expected, as well as drugs without any such expectations.

Methods

Information on prescriptions and traffic accidents were obtained from population-based registries. The Norwegian population aged 18-69 between January 2004 and September 2006 was studied (3.1 million people). The Norwegian Road Accident Registry and the Norwegian Prescription Database were coupled based on the unique identification number assigned to all individuals living in Norway. The drug exposure period was defined as the first week after the day of dispensing the drug. Standardized incidence ratios (SIR) were calculated by comparing the incidence of accidents among subjects prescribed the drug in question with the incidence among unexposed subjects.

Results

During the study period 20,494 road accidents with personal injuries occurred. The accident risk was in general highest for men, and higher for the younger ages. The road traffic accident risk was increased for those who had received prescriptions for any medicine (SIR for both genders combined = 1.4; 95% CI: 1.3-1.5). About the same SIRs were found for subjects exposed to antidepressants and NSAIDs. The risk was further increased for subjects exposed to natural opium alkaloids (2.0; 1.7-2.4), methadone (2.1; 1.4-3.1), non-benzodiazepine hypnotics (2.3; 2.0-2.7) and tranquilizing- (2.9; 2.5-3.5) and hypnotic (3.3; 2.1-4.7) benzodiazepines.

Conclusion

Confounding factors related to the state of needing prescribed drugs may have played a role in this study. The increased risk of traffic accidents for subjects prescribed drugs with abuse and sedating potential, supports results from previous studies, and did in particular represent new knowledge related to the commonly used medicines zopiclone and codeine.

Background

It is well documented that driving under the influence of alcohol leads to traffic-relevant impairment (Schnabel, Hargutt & Krüger, 2010) and implies an increased risk of involvement in traffic accidents (Blomberg, Peck, Moskowitz, Burns & Fiorentino, 2009) Even though driving under the influence of non-alcohol drugs has been less studied than driving under the influence of alcohol, there is evidence that certain non-alcohol drugs may have a similar traffic deteriorating effect as alcohol (Vindenes et al., 2012). To reach this conclusion, different study designs have used unlike aspects of traffic relevant impairment as end-points (Mørland, 2000). The majority of these studies have concerned drugs with a potential for abuse, e.g. cannabis, opioides and benzodiazepines.

Epidemiological studies on traffic accident risk related to driving under the influence of prescribed drugs demand systematic collections of large numbers per medicinal drug of interest. Since 2004, Norway has had a national database covering all prescriptions dispensed outside hospitals (Furu et al., 2010). By connecting these data with the national database of road traffic accidents, it is possible to find the relationship between prescribed medicines and traffic accident involvement for the Norwegian population. So far, seven such studies on different medicinal drugs have been published (Engeland, Bramness, Mørland & Skurtveit, 2007; Bramness, Skurtveit, Mørland & Engeland, 2007; Gustavsen et al., 2008; Bachs, Engeland, Mørland & Skurtveit, 2009; Bramness, Skurtveit, Mørland & Engeland, 2012; Bramness, Skurtveit, Neutel, Mørland & Engeland, 2008; Bramness, Skurtveit, Neutel, Mørland & Engeland, 2009).

Aims

We aimed to summarize the results from the seven population-based Norwegian publications on road traffic accident risk among drivers being exposed to prescribed medicines.

Methods

Registries

All studies have coupled data from three Norwegian population-based registries: the Central Population Registry (NCPR), the Norwegian Road Accident Registry (NRAR) and the Norwegian Prescription Database (NorPD). The NRAR contains information about drivers involved in road traffic accidents with personal injuries. Information about the blame apportioned to drivers was not available. The NorPD captures only prescriptions outside hospital and does not contain any information on when the dispensed medicines were used.

Data handling

All citizens registered in the NCPR aged 18-69 years (3.1 million) were coupled to the NRAR to identify drivers who had been involved in traffic accidents during the time period April 2004 to September 2005 (Engeland et al., 2007; Bramness et al., 2007) or April 2004 to September 2006 (Gustavsen et al., 2008; Bachs et al., 2009; Bramness et al., 2008; Bramness et al., 2009; Bramness et al., 2012). The data files were thereafter coupled to the NorPD. The drivers were stratified by gender and in ten age-groups (due to the age at January 1st 2005).

Standardized Incidence Ratio (SIR)

The incidence of accidents in the exposed person-time was compared with the incidence of accidents in the unexposed person-time by calculating the SIR (and 95 % confidence interval (CI)). In nearly all papers, we assumed that the drivers used the drug the first week after dispensing it from the pharmacy, i.e. exposed person-time was defined as the first seven days starting at the date after dispensing the drug. Multiple exposure periods were allowed to each person, but only one accident (the drivers were excluded after being involved in a road traffic accident).

Any additional co-prescriptions were allowed for the results shown here. For a more comprehensive view of the calculations, see the original papers. The SIR for incident use after a 180 days of wash-out period was calculated for: antidepressants, codeine, zopiclone, carisoprodol and diazepam.

Results

Table 1 Standardized incidence ratio (SIR) and a 95% confidence interval (CI) for the first seven days[1] after dispensing a drug in the drug group in question.

		SIR (95% CI)		
Drug groups	Accidents (N)	Men	Women	Ref.
Opium alkaloids	114	2.0 (1.5-2.5)	2.0 (1.5-2.6)	Engeland et al., 2007
Benzodiazepine tranquillizers	140	3.1 (2.5-3.8)	2.7 (2.1-3.6)	Engeland et al., 2007
Benzodiazepine hypnotics	27	4.1 (2.6-6.2)	1.7 (0.6-4.0)	Engeland et al., 2007
Sedating antidepressants	204	1.4 (1.2-1.7)	1.5 (1.2-1.8)	Bramness et al., 2008
Nonsedating antidepressants	884	1.6 (1.4-1.7)	1.6 (1.5-1.8)	Bramness et al., 2008
NSAIDS	101	1.6 (1.2-2.1)	1.5 (1.0-2.0)	Engeland et al., 2007
Penicillins	44	1.4 (1.0-2.0)	0.7 (0.4-1.2)	Engeland et al., 2007
Any prescribed drug	977	1.4 (1.3-1.5)	1.3 (1.2-1.4)	Engeland et al., 2007

[1]For sedating and nonsedating antidepressants the calculations were based on the number of days corresponding to the number of defined daily doses (DDDs) prescribed.

The 3.1 million included persons were involved in 12,865 road traffic accidents until September 2005 and 20,494 accidents until September 2006. The accident risk was in general higher for the younger age-groups compared to the older (results not shown).

Table 1 shows the risk of being involved in a traffic accident for groups of medicines and table 2 for certain specific drugs. The risks shown in Table 1 and 2 were in general higher for men than for women. Table 1 shows an increased road traffic accident risk related to benzodiazepines or opium alkaloid exposure. Exposure to any prescribed medicines gave a moderately increased SIR, quite similar to what was found for antidepressants, NSAIDs and penicillins (for men).

Table 2 Standardized incidence ratio (SIR) and a 95% confidence interval (CI) for the first seven days after dispensing the drug in question.

Prescribed drug	Accidents (N)	SIR (95% CI)		Ref.
		Men	Women	
Carisoprodol	66	4.0 (2.7-5.6)	3.6 (2.5-5.0)	Bramness et al., 2007
Methadone	23	2.4 (1.5-3.6)	1.1 (0.2-3.1)	Bramness et al., 2012
Codeine	181	2.0 (1.6-2.4)	1.8 (1.4-2.3)	Bachs et al., 2009
Zopiclone	129	2.5 (1.9-3.1)	2.2 (1.7-2.8)	Gustavsen et al., 2008
Zolpidem	21	2.4 (1.2-4.3)	2.0 (1.0-3.7)	Gustavsen et al., 2008
Nitrazepam	27	2.8 (1.7-4.5)	2.4 (1.1-4.6)	Gustavsen et al., 2008
Flunitrazepam	18	4.9 (2.7-8.0)	2.2 (0.5-6.4)	Gustavsen et al., 2008
Diazepam	72	2.9 (2.1-3.9)	2.6 (1.8-3.8)	Bramness et al., 2007

Table 2 shows a clearly increased road traffic accident risk related to carisoprodol, diazepam, nitrazepam or zopiclone exposure. For methadone and flunitrazepam the risk was significantly increased for men only, which may be explained by a low exposed person-time for these drugs. Exposure to zolpidem or codeine gave moderately increased SIRs. The SIR was not increased after exposure to lithium or valproate (Bramness et al., 2009) (results not shown).

Incident use lead to the following SIRs (both genders combined): sedating antidepressants: 1.0 (0.7-1.4), nonsedating antidepressants: 1.6 (1.3-1.9), carisoprodol: 1.9 (0.7-4.1), diazepam: 3.3 (1.6-5.8), zopiclone: 2.1 (1.3-3.1) and codeine: 1.1 (0.7-1.5).

Discussion and conclusions

We found that the risk of being involved in an accident as a driver was slightly increased in users of prescribed drugs in general, and substantially increased in users of benzodiazepines and opioids; in particular related to carisoprodol, codeine, zopiclone, zolpidem, nitrazepam and diazepam. The risk was in general highest for men and the younger ages.

Strengths of this method were that the entire Norwegian population (3.1 million) was included, and that a good data quality was ascertained by using population-based registries.

We had no information about whether (or when) the prescribed medicines were taken. There may have been factors related to the need of prescribed medicine leading to an increased traffic accident risk other than, or in addition to, the drug itself, e.g. that the disease itself may have increased the risk (confounding by indication). Further, the group of patients who receive prescriptions of benzodiazepines or opioids, or psychiatric patients, may tend to use more alcohol and narcotic drugs compared to healthy individuals (Lader 2011; Mordal, Bramness, Holm & Mørland 2008.) We had no information about possible use of alcohol, narcotic drugs and non-prescribed medicines. Other studies on road traffic accident risk point to a particular group of individuals being at the highest risk, consisting of young men who probably represent a risky behavior including excessive alcohol, narcotic and drug use (Legrand et al., 2013). The SIRs in this study also demonstrated higher risks for younger men which to some degree may support the assumption of a marginalized group of people being at the highest risk. However, the increased accident risk related to certain medicinal drugs was in accordance to former studies on traffic accident risk that have used other study designs (Legrand et al., 2013; Dassanayake, Michie, Carter & Jones, 2011), which supports the usefulness of this study design and confirms a particular risk connected to these medicines. For the commonly prescribed drugs zopiclone and codeine, this setup revealed new knowledge.

A somewhat lower SIR was found for incident use after 180 days of washout for antidepressants, codeine, zopiclone and carisoprodol, but not for diazepam. This may be explained by a low degree of tolerance for all drugs except for diazepam. More likely, these results may have been disturbed by a selection bias: persons who receive the prescription infrequently differ from those who receive it often.

Our conclusion is that patients should be warned against driving the first 1-2 weeks after receiving a prescription of psychoactive drugs.

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Risk estimations based on data from experimental studies, epidemiological studies and meta-analysis on driving under the influence

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Abstract

Background
Psychoactive substances are still a major reason for a large portion of heavy accidents. Nonetheless, large scale studies for assessing prevalence and risk particularly of illicit drugs and medicines in Europe are missing.

Aims
One important aim of DRUID was to gain new insights into the real degree of impairment caused by psychoactive drugs and to give recommendation of thresholds for psychoactive substances in traffic based on the different data pools within DRUID.

Methods
In DRUID, three different methodologies were applied in order to estimate traffic risk for driving under the influence of alcohol, drugs and medicines. (1) Meta-analyses of experimental studies on the impairing impact of alcohol, illicit drugs and medicines on driving-relevant performance indicators. (2) Experimental studies on the impairing potential of additional substances and of their combination with alcohol or sleep deprivation. (3) Epidemiological studies to quantify the prevalence and risk of different substances by roadside and hospital studies. Unfortunately, all three approaches lead to different parameters describing impairment or risk in an incomparable way. Within DRUID a method was developed to compare these different estimations, at least for alcohol, for which all three sources of information are available.

Results
It is shown that risk measures for different alcohol concentrations calculated from meta-analysis and experiments are in line with epidemiological risk for specific alcohol levels and comparable with former epidemiological risk studies for alcohol. Therefore it can be assumed that odds ratios calculated from meta-analysis and experiment are a fair estimation of epidemiological risk.

Impairing effects of stimulants could not be verified – neither in the experiments nor in meta-analysis. According to experiments and meta-analysis, a THC serum concentration of about 4 ng/ml shows similar impairment as 0.5 g/L alcohol. According to the meta-analysis the risk for medicines varies of course considerably for different substances even within one substance class and for different doses and concentrations.

Discussion and conclusions
The risk in traffic is inherently defined by a combination of the risk of a specific substance and its prevalence in traffic. Regarding this, alcohol is still by far the most risky substance in traffic in Europe.

Introduction

One major objective of DRUID was to assess the risk of driving with alcohol, illicit drugs and medicines and to deliver substance concentration thresholds for per se legislation. Therefore the results of all epidemiological and experimental studies conducted in DRUID are integrated in this paper.
In case of combating driving under influence of alcohol, legislative regulations and enforcement practices are clearly defined. Regarding alcohol a clear correlation between consumption, blood concentrations and the score of driving impairment is proved for several years, whereas up to now defining limits for combating drugged driving comprises a lot of challenges. Thus per se limits for alcohol are based on scientific risk research which is a prerequisite to assure the compliance of the population with these regulations. Determining legislative regulations against drugged driving is more difficult, as a variety of aspects have to be taken into account. Especially defining risk thresholds for psychoactive substances is a challenging task.

Different Methods for different data pools

Epidemiology
The most relevant information in order to determine thresholds is the information about the accident risk in traffic dependent on different substance concentrations. Direct information about the accident risk in traffic can only be gained by conducting epidemiological studies. Thus the most important data pool for estimating the risk of psychoactive substance use in traffic is based on roadside and hospital studies in DRUID. Risk calculations were done mainly as according to the usual practice by combining prevalence information (DRUID D 2.2.3 Part I & II) and accident information (DRUID D 2.2.5 and DRUID D 2.3.5). For the purpose of comparison with the other data pools, odds ratios were additionally calculated against the reference risk of BAC 0.05 g/L.

Experimental data
In order to make information from the experiments comparable to the risk measures of epidemiological data, two steps were necessary: First, the establishment of a reference risk which was set at a BAC of 0.05g/L. Consequently in every experimental setting a 0.05 g/L BAC condition was added to the other experimental conditions. Second, a pragmatic way of calculating odds ratios from experimental data was developed by treating drivers in the tested substance condition with a driving performance worse than the 0.05 g/L BAC reference as "accident" and drivers with a driving performance better than the 0.05 g/L BAC reference as "non-accident". For methodological details see DRUID D 1.1.1.

Meta-analytical data
Because prevalence rates of most of the substances (especially by differentiating concentrations) are by far too low in free traffic to estimate epidemiological risk, a further data pool was used to provide additional information. Over the last decades a huge amount of studies was published looking at the effects of different medicines and drugs on performance measures. Thus a meta-analytical approach is used. First a reference function between concentration and impairment was established by a meta-analysis of alcohol (DRUID D 1.1.2a). Second a meta-analysis was done for medicines and illegal drugs and (DRUID D 1.1.2b). Again for the purpose of comparison, risk measures were calculated from these single findings in all of the published studies by treating significant results as "accidents" and non-significant results as "non-accidents". Certainly most of the studies report effects at different dosages. As the same dosage leads to different effects on performance in the course

of time, the given dosage information was converted in a concentration information by establishing a time-dependent transfer-function.

Results: The risk of substances

Alcohol

In order to get an impression of the trustworthiness of the calculated risks, the alcohol related risk measures of all data pools were compared with the well-established risk functions from former epidemiological studies (Borkenstein, Crowther, Shumate, 1974; Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2005; Krüger, Kazenwadel & Vollrath, 1995), which were also related to the 0.05 g/L BAC level (see figure 1).

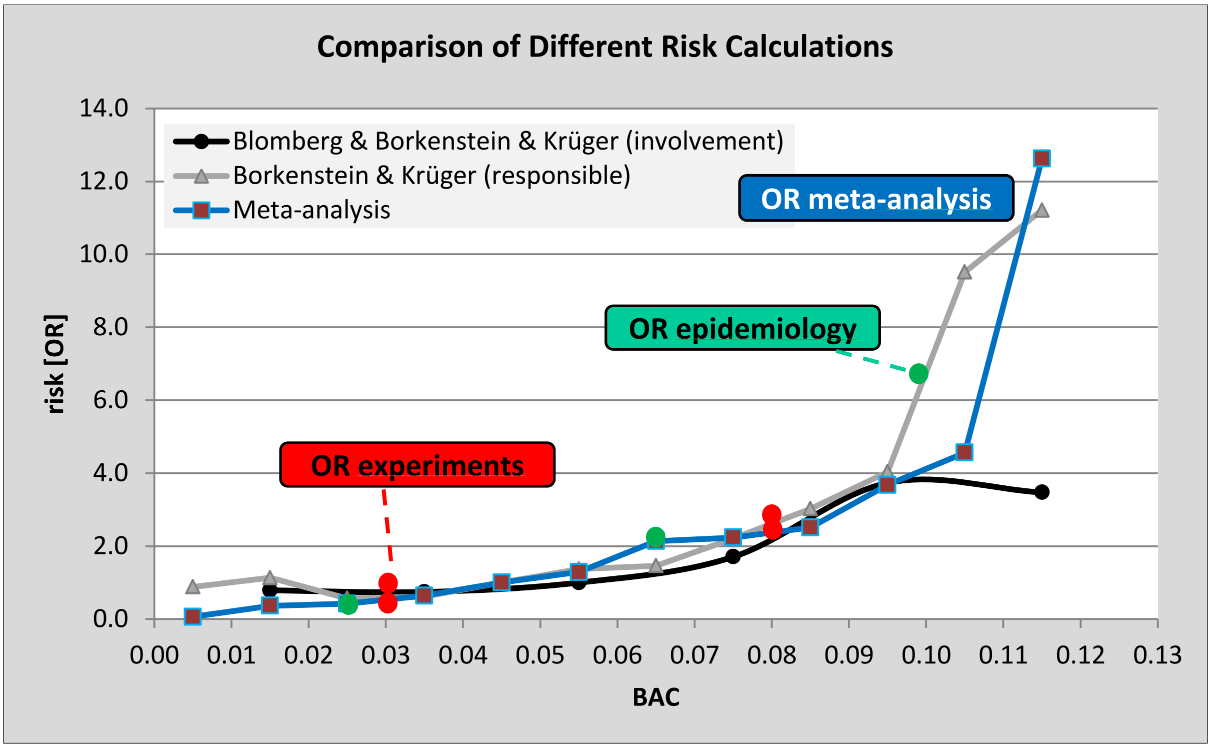

Figure 1: Comparison of different risk calculations (black/grey line: geometric mean of the risks (black: involvement; grey: responsibility) of Blomberg et al. (2005); Borkenstein et al. (1974) & Krüger et al. (1995); blue line: OR from DRUID meta-analysis (Schnabel et al., 2010); red dots: OR from DRUID experiments; green dots: OR from DRUID epidemiology (risk injury).

When inserting the DRUID risk compared to 0.5 g/L alcohol in the three big epidemiological studies (also referenced to 0.5 g/L alcohol) Figure 1 emerges:

- The DRUID risk (green dots) of being injured in an accident are approximately comparable to the risk of both established studies (involvement and responsible).
- At higher alcohol concentrations (1.0 g/L) the DRUID risk seems to more at a level with the established risk of being responsible for an accident.
- The risk calculated from meta-analysis is quite in line with the established studies and seems to be between the risk of involvement and of being responsible above concentrations of 1.0 g/L.
- Even the risks calculated from experiments are comparable to the established risk functions.

The main issue of this comparison was not to define a new risk function or threshold for alcohol, but to validate the highly pragmatic approach to calculate risk measures from meta-analysis and experiments. Of course the so estimated "risk-alike values" are not meant to be interpreted on a very exact level. But it seems that the risks calculated from meta-analysis and experiments using the 0.5 g/L alcohol reference lead to roughly comparable risks as well established studies. This is a very important result for interpreting concentration based risks for illicit drugs and particularly medicines, for which mainly meta-analytical results are available.

Illicit Drugs (THC)
When it comes to cannabis the prevalence rates in the general driving population vary between 0.1 % (DRUID D 2.2.2) and 3.3 % (estimation from the control group of a culpability study in France: DRUID D 2.2.4) with a mean European estimation of 1.3%. That is a higher prevalence than for most of the other tested substances but still much lower than the prevalence of alcohol. The risk estimations mainly vary between 1 and 2, regardless of being injured, being killed or being culpable for a fatal accident. Even analyzing different THC concentrations the risk for an injury is between 1 and 3, even for concentrations above 5 ng/ml serum. Trusting the risks from the meta-analytical approach the risk is "only" 2-fold up to concentrations of 10 ng/ml serum compared to 0.5 g/L alcohol. In experiments 10 and 20 mg of dronabinol lead also to no distinct effects compared to 0.5 g/L alcohol.

Medicines
In experiments alprazolam (0.5 mg) was related to a significant decrease of driving performance. Epidemiology reveals a low risk for injury (1.5-3) and a higher risk for a fatality (5-7) for the group of "benzodiazepines and z-drugs". The risk of medicinal opioids is high for injury (5-8) but lower for a fatality (about 5).
But most of the information regarding medicines can be derived from meta-analysis. On the one hand the risks of the single medicines calculated from meta-analytical data show in most of the cases a clear relation between concentration and risk. On the other hand one has to be aware of the fact, that the odds ratios are only a very crude estimation of the real risk and therefore have to be interpreted with care. The following substance concentrations show the highest risks with an odds ratio higher than 5 as compared to the 0.5 g/L alcohol reference: Promethazin > 6 ng/ml, alprazolam > 9 ng/ml, diazepam > 600 ng/ml, lorazepam > 10 ng/ml, meprobamapte > 40000 ng/ml, triazolam > 7 ng/ml and flunitrazepam > 9 ng/ml.
In general the risk estimations of the different studies indicate that psychoactive medications can constitute a problem in traffic safety. Therefore, both health care providers and patients should be properly informed and aware of the potential risks associated with the use of these medications.

Alcohol equivalents

A further objective mainly of the meta-analytical approach was to determine substance concentrations which show comparable impairing effects as 0.05 g/L alcohol. Although from a legal point of view an impairment approach makes only limited sense for legal medicines, risk thresholds in traffic are often discussed for illegal drugs (especially for THC). Based on DRUID data the proposed risk threshold for THC equivalent to 0.5 g/L alcohol is 3.8 ng/ml serum with an added value for measurement error and confidence interval.

Discussion and conclusion

Figure 2 illustrates the "position" of each substance with respect to prevalence and injury risk[1]. The three substance categories, which are connected with extreme high risks (OR>10), are the two high alcohol concentrations (0.8-1.2 and > 1.2 g/L) and the combination of alcohol and drugs, all of them presenting with moderate prevalence rates of about 0.4%.

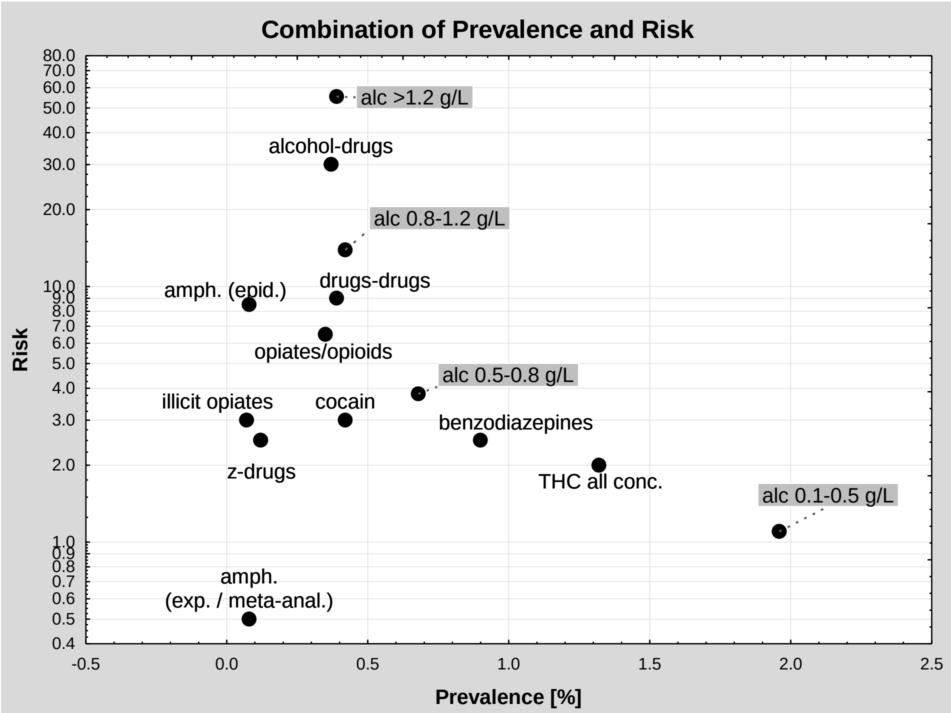

Figure 2: Illustration of prevalence and risk (logarithmic scaling) for the DRUID substance categories.

So from the perspective of traffic safety – especially looking at prevalence rates and risk at the same time - the following statements can be done:

- Alcohol, especially in high concentrations must remain focus number one.
- The combination of alcohol and drugs or medicines seems to be a topic, which should be addressed more intensively because it leads to very high risks in traffic.
- The problems of medicines in traffic should be addressed by information of doctors and patients, not by defining thresholds.
- THC and amphetamines are a minor risk factor from a scientific point of view.
- More research is needed to investigate probable risks of amphetamines in real traffic and the mediating factors.

[1] For this illustration and further discussion injury risk is preferred instead of fatality risk because of more reliable data.

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Exploring cultural, social and psychosocial influences on women's drinking across the life span

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Abstract

Background
Changing trends in women's alcohol consumption have demonstrated that women, in both younger and older cohorts, are drinking at increased levels than previously. However, little research investigates these changing trends or the influences behind them.

Aims
The current research aims to identify influences on women's drinking across a range of age groups, with a focus on multiple level influences (i.e. cultural, social and psychosocial).

Methods
One hour semi-structured telephone interviews were conducted, in 2011, with 35 women (aged 18-55) residing in Australia. Interview development was guided by an adaptation of Bronfenbrenner's Bioecological Model of Development (BBMD) to assess multiple areas of influences from cultural through to psychosocial.

Results
Interview findings highlighted the existence of multiple levels of influence on women's drinking and thus provided support for the BBMD framework. Cultural influences identified related to gender roles and national identity. Exosystem influences (e.g. legislation and infrastructure) and Microsystem influences (e.g. immediate social networks) were also identified. A range of psychosocial factors, such as identity, normative influence and attitude were also found as influencing drinking behaviours. Finally, changes across a woman's life span, a Chronosystem construct, also emerged as a key influence.

Discussion and conclusions
This study has provided an in-depth understanding of women's drinking in terms of the key factors, occurring across multiple levels of influence and across different age cohorts. Changes in alcohol-related attitudes and behaviours were evident across the life span. Future research should extend upon these findings based on larger, quantitative studies. The findings do provide key insights into the influences that need to be addressed within targeted interventions.

Introduction

Rapid and substantial changing trends in women's alcohol consumption have demonstrated that women are drinking at higher levels than ever before (ABS, 2006, 2012; AIHW, 2005). This increase in drinking behaviour is not confined to the younger female population, but is also occurring in the older female age group (ABS, 2006, 2009, 2012; AIWH, 2005, 2008; Measham & Ostergaard, 2009). The literature suggests that women's drinking behaviour is distinct from their male counterparts, and that wider social and psychosocial influences may be important in understanding this behaviour (Corzine, 2010; Roche et al., 2008). However, little research investigates these changing trends or the influences behind them. Bronfenbrenner's Bioecological Model of Development (Bronfenbrenner & Morris, 2006) has been used as a framework that incorporates multiple levels of influence on behaviours (Ayoola, Nettleman, & Brewer, 2007; Bogg & Finn, 2009). Thus, the current research examined influences on women's drinking across a range of age groups, using an adaptation of Bronfenbrenner's Bioecological Model of Development, herein termed BBMD (See Figure 1) to organise the key influences emerging in the data within these levels.

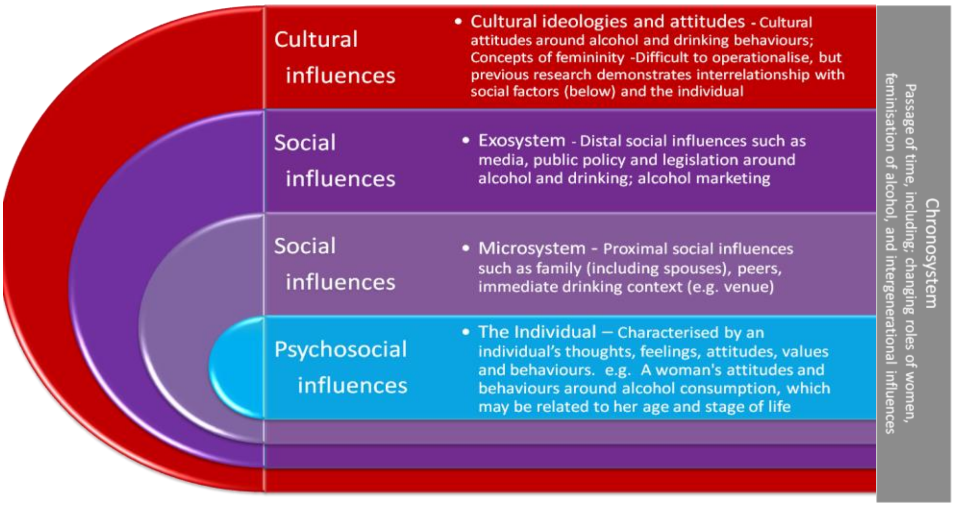

Fig. 1: Framework guiding the study and underpinned by Bronfenbrenner's Bioecological Model of Development (Bronfenbrenner & Morris, 2006).

Methods

One hour semi-structured telephone interviews were conducted with 35[1] women (18-55 years old). Question development was informed by a previous observational study and guided by BBMD to identify multiple areas of influences, ranging from cultural through to psychosocial level influences. Purposive sampling enabled insight into the alcohol-related attitudes and behaviours of different age groups of women. The first author conducted all of the interviews, and analysed the transcribed data using NVivo8(TM). Whilst BBMD served as a organising framework, an inductive approach analysis allowed key themes to emerge. Each interview was coded by units of meaning that were compared within interviews and then across interviews. Consistent with the constant comparative method (Boeije, 2002; Glaser & Strauss, 1967) these ongoing comparisons refined the categories, thus facilitating the classification of higher level themes. Regular peer reviewing (with research team members) occurred throughout the analysis.

Findings

Interviewing women about their alcohol-related attitudes and behaviours revealed the extent to which alcohol consumption is embedded in many facets of Australian life. The findings underlined how Cultural, Social (Exosystem and Microsystem) and Psychosocial factors influenced the individual, in terms of their drinking behaviours (Table 1). Consistent with BBMD, the themes that emerged from the interviews fell into multiple-levels of influence. Table 1 provides a summary of some of the key influences emerging in relation to each level. Findings at each of the levels will be discussed below together with supporting participant quotes.[2]

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[1] Initially 36 interviews were conducted, but one participant was excluded due to concerns about the validity and reliability of the data that was collected, predominantly as she struggled to answer the questions.
[2] Supporting quotes are referenced with pseudonyms to protect participant identities. The numerical value is her real age at the time of the interview.

Table 1: Key influences identified in relation to each level of influence

Level of influence		Key themes
Cultural		Engrained in Australian Culture and part of the National identity Gender roles
Social	Exosystem	Infrastructure (e.g. public transport; drinking establishments) Legislation (drink driving, legal drinking age)
	Microsystem	Immediate social networks (e.g. peers, family, partner, work colleagues)
Individual	Psychosocial	Identity Attitude Normative Influence
Chronosystem		Changes in attitudes and behaviours across the life span

Cultural influences

Interview data indicated that two main factors functioning within the Cultural system influenced women's drinking: (i) the extent to which alcohol is embedded in Australian culture; and (ii) the adherence to culturally prescribed notions of femininity and gender roles in women's drinking. The women believed Australian culture endorses and values alcohol consumption. Women discussed drinking as being engrained in "Australian culture" (Tiffany30; Frances35; Gemma35 Dora36; Jade46; Ivy54) and part of what it means to be Australian (Hazel30). By example, statements included *"I think it's quite like culturally ingrained."* (Bridget25) and *"I think society values drinking alcohol as being quite an acceptable thing to do."* (Dora36).

Culturally prescribed femininity and gender roles appeared to influence women's alcohol consumption, where women gave accounts of acceptable drinking behaviours that did not impinge upon societal notions of femininity. Amanda35 recalls a time when she was 19 and bought a pint of cider, resulting in her mother's admonishment, *"Oh it's so unfeminine to have a pint!"*. The women's narratives brought to light attitudes about femininity and gender-prescribed ways of drinking. Lisa34 was quick to point out, *"Not that I'd do anything terrible, but I just wonder you know, if I have been lady-like or if I've been a bit more forward than I would perhaps allow myself to be if I hadn't drunk anything."* (Lisa34) and *"She has a very strange . . . she has a lot of brothers so her attitude to drinking is quite boy-ish."* (Toni18).

Contemporary gender roles were discussed as impacting upon drinking behaviours particularly in relation to changes in marital status (Eve23; Erin25; Elouise30; Ada31; Amanda35) and/or becoming a mother (Tracy21; Elouise30). These role changes often affected where and how much alcohol was drunk. For example, Toni18 explained that as a single woman, venue choice depended upon her ability to maximise opportunities to meet people. Since meeting a partner, however, she reported that her drinking had changed but she hypothesised, *"If I was single I might drink more, I might go out more."*(Toni18) Frances35, like a number of women, described how her friends with children reduced their consumption, *"They need to watch the kids"* and *"they just can't look after kids with a hangover."*(Frances35) In contrast, Zara41 increased her consumption as a result of becoming a mother, *"I never really drank until I had kids."* (Zara41)

Exosystem influences

In terms of Exosystem influences, infrastructure (e.g. public transport; accessibility to drinking venues) and legislation (e.g. drink driving laws; drinking age of consent) were two factors identified as influencing women's drinking behaviours. The most notable influence was infrastructural, wherein location and accessibility of drinking venues (e.g., clubs, bars and restaurants), as well as transport options repeatedly was identified as influencing women's drinking. Furthermore, infrastructure together with drink driving legislation, influenced women's drinking in terms of: decreasing women's drinking when one had to drive to a venue, influencing the desire for accessible venues; and increasing the reliance upon public transport. Erin25 stated, *"I won't go to a party if I'm a sober driver, because I won't have fun."* Tiffany30 discussed how moving towns increased her drinking because she could now walk to venues:

> *I would probably go out to a club or something more nowadays than . . . We are now living quite close [to bars and restaurants] . . . and it's not having to [drive], we used to have to get trains and stuff into the city in Brisbane.* (Tiffany30)

Legislation was also identified in relation to legal drinking ages. Specifically, some of the women portrayed a variety of ways in which their drinking had changed once they had turned 18 years of age, the legal purchasing age across the States and Territories in Australia(National Drug Research Institute, 2007). Some women (e.g. Toni18; Jennie21; Zoe21; Tiffany30) described transitions from the *"excitement"* of private under-age parties, to going out drinking as an 18 year old, which became rather mundane. *"When I finally got to the point where I could go out and legally drink it just wasn't a big deal anymore."* (Eve23). Jennie21 states, *"When I first turned 18 I pretty much went out every weekend for the first six months and drank. So maybe I'm just sort of over it...it's just not fun anymore."*

Microsystem influences
Microsystem factors primarily related to the women's social networks in their immediate environment. These networks included peers, partners, family, and work colleagues, and were all indicated as important influences affecting the individual's alcohol-related attitudes and behaviours. The influence of such social networks on a woman's drinking was perhaps most notable when there was a change to one of these networks. Ada31 provided accounts of numerous peer group changes as she travelled and changed jobs that impacted on her drinking until, *"I started making really good friends and that's when I met my husband as well. . . I started picking up my social life and I started drinking more."* (Ada31).

Psychosocial influences
Comparing the number of influences identified at each level, the most influences overall were identified at this level. Due to the scope of this paper, however, focus will be on just three of the key psychosocial influences on women's drinking identified. The degree of identification with being a "drinker"; attitudes; and normative expectations, emerged as some of the key psychosocial influences impacting on women's drinking behaviours. The women regularly labelled or identified themselves or others along the lines of being a "drinker" or "not a drinker". The degree to which the women identified with drinking behaviour seemed to be related to their attitude towards drinking and drunkenness (e.g. those that identified as "a drinker" positively valued drinking). Further, identification as being 'a drinker' influenced the way in which they viewed others' drinking. By example, Ada31claimed, *"I'm not a heavy drinker"* and labelled her friends as *"Happy drunks"*. Correspondingly, her attitude toward drunkenness implied that it was okay for others to get drunk.

The concept of alcohol-related identities was featured in numerous interviews and closely related to labelling of others' drinking identities. For example, Toni18 stated, *"I'd never been a heavy drinker."* Laura27 affirmed *"I will actually drink pretty much anything ... if I had to pick out one type of spirit it would be gin. I consider myself a gin drinker."* and later mentioned, *"Our mother is not a big drinker"*. Participants were both executors and subjects of alcohol-related labels. Discussing her sister's drinking behaviours, Tiffany30 labelled her sister as, *"a stick in the mud when it comes to doing fun things"*. In comparison, Mandy28 received labels of, *"the straighty of the family"* and *"uptight"* by her sister because she drunk less. It is noteworthy that throughout her interview, Mandy28 referred to her own drinking behaviours as, *"uptight",* thus possibly having incorporated her sister's labelling into her own alcohol-related identity.

Most women viewed drinking as an expected behaviour among their social networks. Eve23 illustrated the impact of key normative influences, *"I guess a lot of the people I know just enjoy it. Enjoy having a drink and a barbecue you know and that sort of thing. It just becomes a part of what they expect the day to be so everybody else joins in."* Similarly, Jennie21 noted,

> *With my friends...if it's their birthday or whatever they want me to drink. I don't see it as peer pressure because I always have the choice, it's not like they're not going to be friends with me if I don't drink ... But I guess I drink more around them.*

Normative influences upon women's drinking did not just emanate from their peers. The interview data demonstrated influences from a range of social networks within a woman's Microsystem (e.g. family, work colleagues).

Key attitudinal-related influences evident in the findings were: perceived advantages and disadvantages of drinking; attitudes toward drunkenness; and attitudes around limiting consumption. Not surprisingly, attitudes varied across the individuals in the study: Amy18's attitude toward drunkenness, *"I think it's disgusting and I think you have to not lose yourself, you have to still present yourself as a respectable person."* Is contrasted with Laura27's, *"I do like the feeling of being drunk ... like feeling stupid occasionally in those situations."*

Chronosystem factors

Across all of the levels of influence (i.e. Cultural, Exosystem, Microsystem and Individual) there was evidence of the Chronosystem, or the changes occurring across time (Bronfenbrenner & Morris, 2006). The primary Chronosystem construct identified related to life events/changes that occurred for the women and resulted in drinking behaviour changes.

Across the lifespan women's exposure to the alcohol-related influences at different levels could change as a result of life choices made (e.g. job transition; move) or stage of life. All of the women described such changes across their lives. Evidence of the Chronosystem across multiple levels of influence was exemplified by Ada3's account of moving countries (Cultural), wherein different drinking locations (Exosystem) and changes in work and peer groups (Microsystem) affected normative expectations and attitudes (Psychosocial) altering her drinking behaviours.

Conclusion

This study has provided a preliminary, yet in-depth, qualitative understanding of the key factors impacting women's drinking across age cohorts and across multiple levels of influence. The findings thus provided support for Bronfenbrenner's Bioecological Model of Development the extent to which, factors across levels functioned to interact. Interaction between constructs is exemplified by the relationship between social networks (Microsystem) and identifying as a drinker, attitudes and normative influence (Psychosocial). Further, interactions between infrastructure, public transport, and drink driving legislation signify the importance of these influences on women's decisions around drinking and driving and underscore possible areas of intervention.

The findings indicated that it is at the most proximal levels, at the Microsystem and Psychosocial level, that key influences clearly and readily emerged. The women in this study more readily identified these direct influences. These findings are consistent with Bronfenbrenner's framework in that individuals have a direct relationship and are actively engaged with factors at a Microsystem level even though these factors are themselves a function of the more distal or indirect influences (Bronfenbrenner & Morris, 2006).

Findings also highlighted that across the lifespan women were exposed to different alcohol-related influences (i.e. the constructs outlined in this research) as a result of a life choice made (e.g. job transition; move) or stage of life. Future research can build on these exploratory findings and highlight key influences that could be incorporated into targeted interventions. Based on this research, interventions focused at the Microsystem and Psychosocial level should have the greatest impact. However, to focus exclusively at these levels would be limiting as women's drinking is a complex behaviour resulting from multiple levels of influence.

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RS10 China: Social Marketing and Road Safety [1]

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Abstract

Context
In China, the rapid rate of motorization coupled with the high levels of road traffic fatalities and injuries is quickly moving road safety up the public health agenda. The Road Safety in 10 Countries - Brazil, Cambodia, China, Egypt, India, Kenya, Mexico, Russian Federation, Turkey and Viet Nam or the RS10 Project is one of the ways road traffic injury prevention is being tackled in China. The RS10 China Project supports the Chinese Government in the implementation of proven countermeasures and strategies to enhance road safety in the cities of Suzhou and Dalian for eventual scaling up and in-line with China's national plan. Exposure to marketing and behavioural science methodology has been limited among the on-the-ground teams and local technical staff. This paper presents work that introduces RS10 China, Social Marketing models for speeding and drink driving interventions within the Chinese cultural context in 2012.

Objectives
As the RS10 China team assessed and evaluated the initial efforts of the program in 2010 - 2011, an increased demand for capacity building and Social Marketing tools for local implementation was apparent. The objective of the project in 2012 was to bring a *social marketing approach* and build capacity to enable the design and delivery of enforcement and communications related to road safety interventions within the RS10 China program.

Key Outcomes
Focused capacity building resulted in establishing Social Marketing planning and design models, and resources and for use in China. The key stages of development included focused planning and targeting, assessing stakeholder commitments and resources, evidence based methods/data collection/evaluation, and an integrated approach to enforcement/legislation/SM. Review of the available data resulted in the campaigns targeting male drivers aged 30-45 years. Outputs included: materials production and distribution - TV/radio ads/posters/fact sheets, city level and specific grassroots activities, media advocacy and reports, celebrity and community/business leader involvement, and tactical campaign launches. Results of the evaluation of the RS10 China campaigns indicated a high level of reach to target groups.

Discussion and conclusions
Significant progress has been made and demonstration models on Social Marketing were established in 2012. Future challenges include; scaling up of successful models; national legislative changes; stronger NGO involvement; and integrating road safety into Healthy City models.

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[2] World Health Organization

[3] Chinese Center for Disease Control and Prevention

Introduction

The Road Safety Project dubbed 'RS10' aims to support the governments in 10 project countries to implement good practices in road safety in line with their national road safety strategies. In China this is being achieved primarily by focusing on behavioural risk factors of drink driving and speeding in the pilot cities of Suzhou and Dalian.

Social marketing is the application of commercial marketing techniques to public health and social issues (Andreasen, A.R., 1994). The use of social marketing in road safety efforts internationally has shown the need to combine legislation, enforcement and communication efforts to influence behaviours (DELHOMME, 1999). Because road safety campaigns are often seeking to change complex behaviours, rather than encourage consumption of a new product or a change of brand it is important to carefully identify a specific target audience with whom the campaign can offer a benefit or increased barrier to the risky behaviour. In the case of RS10 China, the effort must persuade people to give up a behaviour that they enjoy, such as drinking (when they will be driving afterwards), and do something that is seen as inconvenient, such as driving more slowly. Combining legislation/enforcement with a communication strategy supporting its efforts is a key goal of RS10 China.

As a key component in all RS10 interventions social marketing, is a new concept in China as it relates to road safety. It is not surprising that following the initial stages of the project in China in 2010-11 partners responsible for implementing the project identified a need to significantly increase capacity in social marketing including building new tools, human resources and an evidence based culture.

This paper outlines; the design and implementation of the social marketing programs undertaken during 2012 in pilot cities, the capacity built, lessons learnt and how these will shape the future.

The First Stage: Developing Model and Target Identification

Agreement was reached early in 2012 that in terms of Enforcement and Social Marketing, the planned interventions would focus on single specific risk factors in each city as well as restrict the areas of the city to be the subject of major campaign interventions. In Dalian, *Speeding* and in Suzhou, *Drink Driving* was the focus of dedicated campaigns with continued activities continuing on both risk factors in both cities at a reduced level. A model – *City Wide – District Deep* was developed to encapsulate the proposed strategy wherein mass media would potentially expose the entire target group and more specific enhanced enforcement and community engagement would be trailed in districts with a high incidence of road crashes.

Within this new framework, 2012 began with a Literature Review and Communications Audit to better understand what the environment and audiences RS10 must work with for each city. Through this review the target audience was more carefully defined: The Suzhou Drink Driving Campaign would focus on male, experienced drivers, age 35 to 45. In Dalian, the anti-speeding campaign would focus on a similar audience; male drivers, 35 to 45 years old This more specific target audience (vs. "all drivers" as used in the previous year) lead to a targeted KAP study done in a sample district in each city to identify how the campaign would address this audience and what benefits and barriers exist for the audience to achieve our desired behaviours. The development of the Knowledge, Attitude and Practice (KAP) and focus group tools themselves brought light to the need for technical assistance as resources were limited. As social marketing is an evidence-based approach, it was important that the local city based teams gained the capacity to develop and implement research tools for independent future efforts.

Data gained regarding benefits and barriers that matter to our audience from the KAP and focus groups allowed the team to translate that into communication tactics.

The Second Stage: Capacity Building and Plan development

Social marketing planning meetings and workshop were held in Dalian and Suzhou which placed emphases on the key steps of Social Marketing and timelines of the RS10 China project. Lessons learnt from other RS10 countries, such as Russia, Viet Nam and Turkey were integrated into the programs as was the key message that working closely with the enforcement effort and publicizing the risks of being caught drink driving (based on new legislation) and speeding were key elements of the city plan.

Media advocacy and the use of earned media are an essential part of increasing awareness and educating the public about new legislation (e.g. legal limits of alcohol) as it relates to their driving behaviours. Media workshops were conducted in Dalian and Suzhou on as part of the preparation for mounting campaigns in both cites. Over 50 journalists and editors from major television , radio and newspapers were provided with information and group exercises addressing issues such as ; road safety as a public health issue, the role of the media, the proposed new enforcement measures during the campaigns and new ways of reporting road crashes.

Planning and the development of Plans at the city level was both and an emergent and iterative process. With many key stakeholders to coordinate the process took time to develop as both the technical and more conceptual elements of the Plan needed to be explored with many. Timing of social marketing activities with the enhanced enforcement provided by the local city traffic police was key to the finally agreed Plan.

The Third Stage: Material and Tools development

It is at this stage that the international expertise of the World Lung Foundation (WLF) was applied. Using international experts and looking to resources within the broader RS10 countries proved to be an important part of making resources stretch further for the project and bringing capacity building into the local context.

The WLF process was undertaken during the first half of 2012 and utilized combined qualitative and quantitative methodology was implemented in accordance with a precise research protocol.

Based on assessments by a task force of road safety and social marketing experts, five core speeding advertisements were selected for testing and an additional four advertisements were chosen from a pool of ads that also rated as suitable for the study, as well as one locally chosen by WHO China road safety staff and partners, based on specific relevance to the RS10 objectives in China. In order to be able to assess driver responses to different types of messages, selection of ads for the study was undertaken within three main message categories to ensure representation of:

- Ads that focus on the ***consequences*** of speeding on the driver or others;
- Ads that focus on ***instruction*** of some form about what happens when someone speeds; and
- Ads that focus on ***enforcement*** and the risk of being detected if speeding.

Using the final reports on field testing of TV ads, material production of - 4TV ads, 4 radio ads and 2 posters, key messages and fact sheets on Drink Driving and Speeding were developed to serve as the foundation of a local and national Road Safety Social Marketing Resource Kit for China

Based on the WLF research, KAPs , Focus group and relevant literature the following slogans, key messages and posters were developed for use in the then forthcoming campaigns:

Slogan: Drink Driving, Extreme – Danger

Key Messages:

- Drink Driving significantly increases the likelihood of a crash
- You don't know where the police will be waiting – expect to be tested
- Get caught drunk driving and you'll be processed like any other criminal
- Drunk Driving can result in loosing your life and your family loosing you.
- Driving even with low levels of alcohol is unsafe

Slogan: Save a Life – Slow Down

Key Messages:

- Speeding is not only exceeding the speed limit but driving too fast for the conditions
- Reduced speed leads to reduced death and injury
- Small increases in speed leads to high risk of crashing
- Vulnerable road users are at the greatest risk
- Fixed and Mobile speed cameras will catch speeding drivers
- There is no such thing as "Safe Speeding'

The Fourth Stage: Campaign Implementation and Evaluation

Following the completion of the above activities and submission of social marketing, media and enforcement plans from both pilot cities the first of China's RS10 'evidenced based' Road Safety campaigns were conducted in Suzhou and Dalian. These utilized the now produced TV/Radio and print materials and focused certain enhanced enforcement activities in the selected district levels of each city while maintaining city wide interventions for both risk factors. Given the need for time to develop resources and strengthen human and media resources the first campaigns were not launched until late September in each city.

Campaigns Elements in a Nutshell:

- Enforcement –100 days of enhanced enforcement activity by city traffic police;
- Engagement: activities included use of volunteers and restaurant owners, replacement drivers, six demonstration *drink safety environment* restaurants established;
- Education: TV and radio ads broadcasted, road safety website established, use of social media to send messages and establishment of an information network; and

- Emotion: Goodwill Ambassador – Movie Star Jiang Wenli and victims of road traffic crashes participating the advocacy media events.

SM campaign process evaluation

The process evaluation was undertaken by an independent third party agency who undertook a range of quantitative and qualitative methods including; face to face random survey of approx. 600 target group drivers in each city, focus groups of target group drivers and key stakeholders and in-depth interviews of key local partners responsible for implementation activities.

The overall reach of the campaign in Dalian was 40% with TV /radio and Outdoor Public Display highest in reach. This compared with 37% overall reach in Suzhou with outdoor messages rating highest in reach followed closely by all other media including TV , radio, newspapers and web sites. This reinforced the now generally held understanding of the importance of mass media in social marketing however the high reach of both outdoor advertising in both cities and the use of the purpose built web site in Suzhou are important to note for future campaigns.

However while the social marketing activities can be said to effective in terms of making drivers aware of the campaigns and resulted in a desire to change behaviour , this cannot be said of their apparent knowledge of the more detailed information related to the each risk factor. For example 53% drivers did not know the penalties for over speeding 20%～50% of the speed limit, while there were 51% respondents did not know the penalties for over speeding 10%～20% of the speed limit. While over 90% of drivers in Suzhou new drinking a small quantity of wine was dangerous, only 25% knew the alcohol test standards for drink-driving, and 30% knew the alcohol test standards of drunk-driving. This led the evaluation team to recommend that future campaigns should focus more on details of each key message and less on transmission on general slogans.

Other major recommendations for the future included; making greater use of key media including TV and radio, strengthening media tracking and impact evaluation and increasing the roles of civil society.

Conclusion

The progress made during 2012 within the RS10 China project has succeeded in bringing a *social marketing approach* to the road safety programs in Suzhou and Dalian. This more integrated approach brings the three pillars of the effort – legislation, enforcement, and social marketing together to provide a more cohesive, balanced and methodological/ evidence based approach. This social marketing approach will provide a greater ability to influence behaviours and reduce the selected risk factors in such a rapidly motorizing country rather than focus on education and attitudes alone.

The lessons learnt from this first series of campaigns still bring many challenges including the need to; develop more effective engagement of civil society in delivery of key messages, continue to strengthen the human and technical resources for the design and delivery of social marketing programs and to reinforce the need for evidence based decision making in design and delivery.

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Is the Clinical Test for Impairment a Reliable Tool in Evaluating Impairment from Zopiclone and Ethanol?

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Abstract

Background
When the police stop a driver on the suspicion of drugged driving, it is essential to have the correct tools to help evaluate whether the apprehended driver is impaired or not. In Norway, a comprehensive clinical test for impairment (CTI) is performed by a physician, as a routine procedure, shortly after apprehension. Former research has indicated that such testing is suited for detecting alcohol impairment, but less sensitive for detecting impairment in driving caused by other drugs.

Aim
To compare CTI results with experimental laboratory test results for zopiclone, a commonly used benzodiazepine-like drug, with alcohol as verum.

Methods
A double-blind placebo-controlled randomized trial on 16 healthy male volunteers was performed. The volunteers each attended the research unit in 4 sessions, receiving placebo, 5 mg of zopiclone, 10 mg of zopiclone, or 50 g of ethanol. Blood samples were collected, and psychomotor performance was measured by computerized tests and by selected subtests from the Norwegian CTI.

Results
The performance on the CTI and the computerized psychomotor tests show both a clear concentration-dependant deterioration after consumption of an active substance (zopiclone or ethanol). Seven hours after intake, the performance was again comparable to baseline.

Discussion and Conclusions
The results show that the CTI may be of value in evaluating whether an individual is impaired or not, for zopiclone as well as for alcohol, with a sensitivity similar to that of computerized psychomotor tests.

Introduction

The negative effects of alcohol on driving performance are well documented. Several studies have shown a blood alcohol concentration (BAC)-related increasing risk of traffic accidents (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2009) and deteriorating performance in experimental studies (Schnabel, Hargutt, & Krüger, 2010). The detection of drunk driving, in practice, is well established by the combined use of various standardized field sobriety tests (SFST) and breath alcohol screening.

During the last few decades, driving under the influence of non-alcoholic drugs has received considerable attention and yielded increasing concern (Gjerde, Normann, Christophersen, Samuelsen, & Morland, 2011; Schulze H, Schumacher M, Urmeew R, & Auerbach K, 2012).

As rapid quantitative saliva tests, for all of the non-alcoholic drugs of interest, are not yet available for screening cases of suspected drugged driving, it is important to have a systematic set of observations available to help indicate impairment. This again becomes important both for detecting cases which should be subjected to further examination, and for documenting impairment with the possible subsequent handling of the cases in court. For these purposes, different approaches are presently being applied in different countries, such as the SFST and various other clinical tests of impairment (CTIs).

There is no awareness of any systematic comparison of the SFST or any CTI with the psychomotor performance on the three core levels of traffic-relevant behavior (automotive behavior, level 1; control behavior, level 2; and executive planning behavior, level 3) considered of importance to safe driving (Walsh, Verstraete, Huestis, & Morland, 2008). A systematic evaluation of the psychomotor performance, with reference to the recommended three core levels, cannot be performed roadside, as it has to be done in a laboratory setting and requires special equipment, in contrast to the SFST and the CTIs, which can easily be performed in an actual traffic-related setting.

One of the most frequently detected non-alcoholic drugs among Norwegian drivers is zopiclone (Gjerde et al., 2008), and the risk of being involved in a traffic accident involving person injury is increased among patients being prescribed zopiclone (Gustavsen et al., 2008). Zopiclone may represent other similar drugs acting through the GABA-receptor, and has also been shown to be a drug inducing impairment in an on-the-road driving test (Verster, Spence, Shahid, Pandi-Perumal, & Roth, 2011).

A controlled study was performed on how the outcome of a simple field sobriety test compared to the outcome of psychomotor testing on the three core levels in subjects given one of two doses of zopiclone, ethanol or placebo, in a double-blind crossover design.

Materials and Methods

Study procedure

A double-blind placebo-controlled randomized trial with a crossover design was performed, including 16 healthy male volunteers. The volunteers attended a research unit for four study days, and received in a randomized order either placebo, 5 mg of zopiclone, 10 mg of zopiclone, or 50 g of ethanol. Blood samples were collected on the study day and analyzed for zopiclone and ethanol. Psychomotor performance was measured by a simplified CTI and by three licensed computerized tests. The study procedure is described in detail elsewhere (Gustavsen, Hjelmeland, Bernard, & Morland, 2011).

The blood drug concentrations were grouped into 4 drug concentration quartiles, based upon the measured blood drug concentrations at 1, 3.5, and 6.5 hours after intake (Figure 1). Pearson’s Chi-square test was used to calculate differences in the shares of impaired observations between the different concentration levels, using the lowest quartile as a reference.

Impairment measured by CTI

A simplified version of the Norwegian CTI was performed at 1.5 and 7 hours after intake of the study medication (Figure 1): Gait on line, turning on line, finger-to-finger test, finger-to-nose test, and Romberg's test (standing on one foot for at least 5 seconds, with arms stretched out and eyes closed). Based upon the subtest performance and an "overall judgment", the raters concluded on the subjects being either "impaired" or "not impaired", which was used as a basis for the calculations in this manuscript.

Impairment measured by computerized tests

The computerized tests, including 15 test components, were performed at baseline, and at 1, 3.5, and 6.5 hours after study medication intake (Figure 1). Any test performance worse than the individual´s baseline performance was defined as "impaired", and vice versa (Gustavsen, Hjelmeland, Bernard, & Morland, 2012).

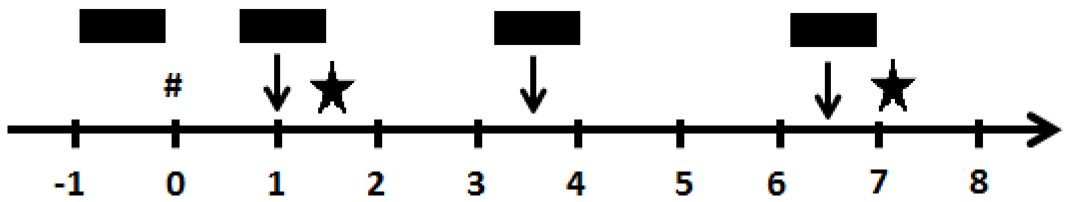
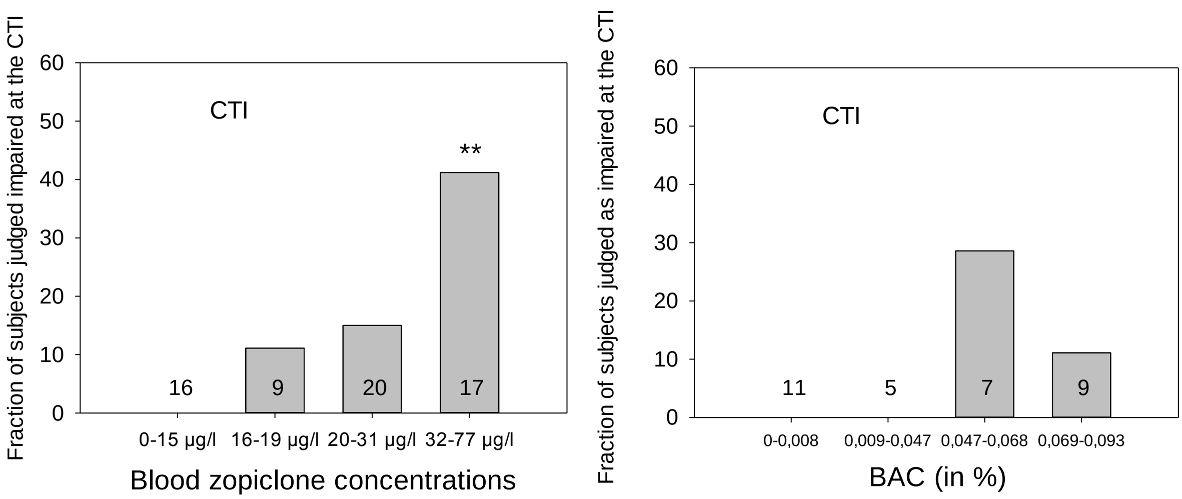


Figure 1 Study day flowchart showing the procedures included in the present paper: Intake of study medication (#); arrows indicating blood sampling; black boxes indicating the time intervals for the psychomotor performance as measured by the computerized tests; and stars indicating the CTIs.

Results and discussion



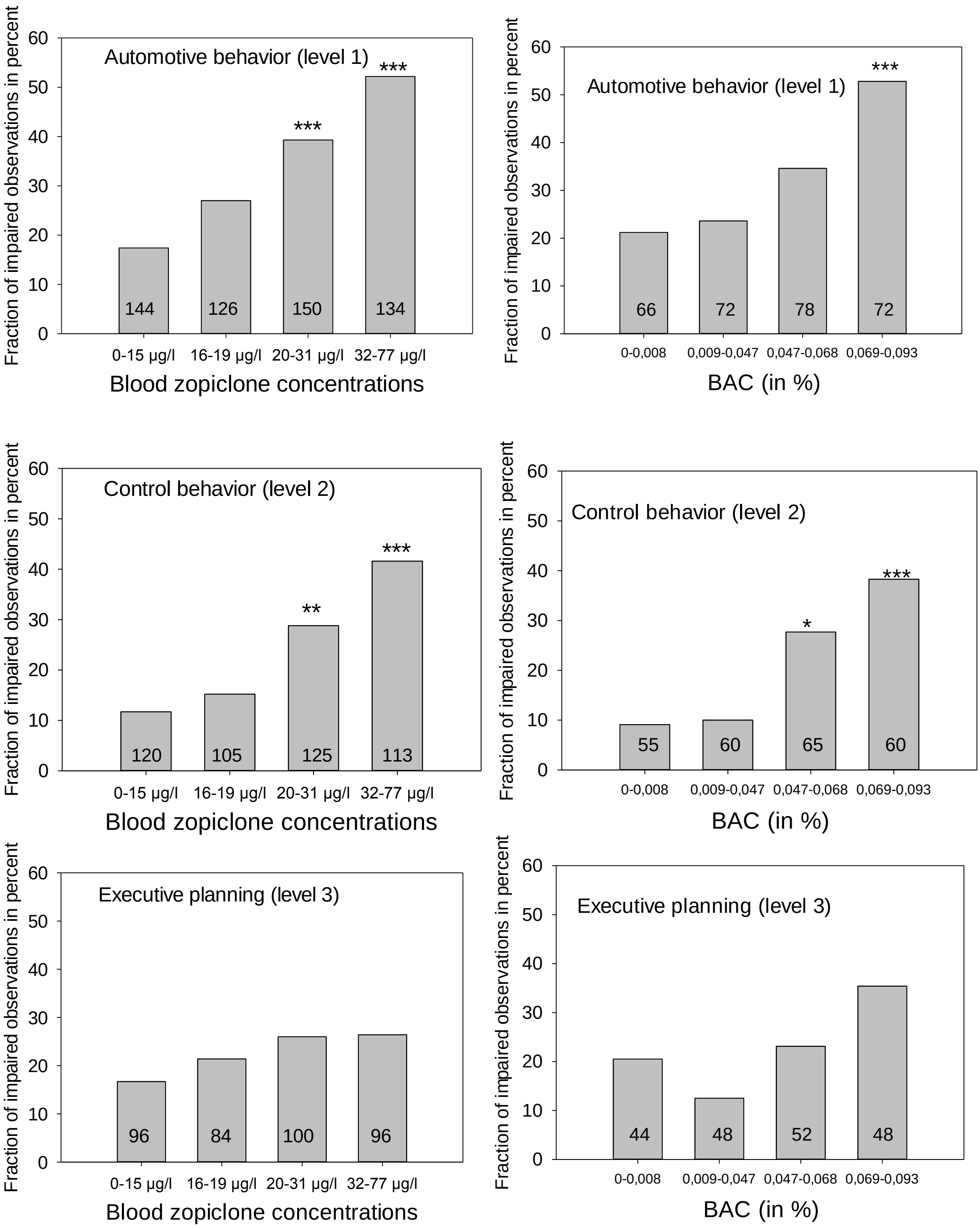


Figure 2 The percentages of impaired individuals as judged by the CTI, and the percentages of impaired observations at the three levels of behavior, both related to blood drug concentrations of zopiclone and to BACs. The concentration levels are divided into quartiles, and for each quartile the percentages of impaired subjects as judged by the CTI, and the percentages of impaired observations at the three levels of behavior, are presented. The number of observations in each quartile is given in each bar. Significant differences are calculated with Pearson's Chi-square test using the lowest quartile as a reference, and are marked by asterisks in the figure: *p<0.05, **p<0.01, ***p<0.001.

For the impairment assessed by the CTI, a positive relationship was found for the blood zopiclone concentrations, but not for the BACs. There was, however, twice as many zopiclone observations compared to that of ethanol, which may explain a stronger dose-dependent correlation for zopiclone.

The results indicate that the CTI is a more reliable tool for revealing zopiclone impairment than ethanol impairment. This stands in contrast to a former study, were a Finnish clinical test for impairment was found to be more sensitive to the intake of 0.8 g/kg of alcohol than that of 7.5 mg of zopiclone (Kuitunen, Mattila, & Seppala, 1990; Kuitunen, Mattila, Seppala, Aranko, & Mattila, 1990). In the previous study, the sensitivity for evaluating dosages, but not for evaluating concentrations, was tested.

For the impairment assessed by the computerized tests, a positive concentration relationship was found for impaired observations for level 1 and level 2, but not for level 3, for both zopiclone and ethanol. Tests for all three levels of behavior are recommended when investigating traffic-relevant impairment. The revealed impairment in automotive- and control behavior but not in executive planning was somewhat surprising. However, it is likely that at higher concentration levels, impairment in executive planning would also have been detected.

The results indicate that the performance of the CTI may be a valuable aid for discriminating between blood zopiclone concentration levels above and below 20 µg/L, and BACs above and below 0.05%. The previous concentration level for zopiclone corresponds approximately to the maximal concentration level achieved within 6 - 10 hours after intake of a regular sleeping dosage of 7.5 mg of zopiclone.

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Unobtrusive Breath Testing

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Abstract

Background
Breath testing today requires cooperation, significant physical effort, and is time-consuming. In order to reach an increased acceptance for general breath testing among drivers and professionals whose sobriety is of importance for a safe work environment, a less obtrusive breath testing procedure is desirable.

Aim
The aim has been to develop a breath alcohol analyser enabling fast, simple contact free breath testing with less physical effort. The sensor should meet the automotive industry's requirements of long-time stability, and short start-up and response time, regardless of the ambient temperature. The long term goal is extensive implementation of an in-vehicle integrated unobtrusive alcohol detection system.

Results
The physiological rationale of the use of CO_2 as a tracer gas has been investigated, and a new non-dispersive infrared gas senor enabling measurements of both breath alcohol and expired CO_2 have been developed. The gas sensor has been evaluated with excellent results in sensitivity, cross-sensitivity. In a controlled drinking study a strong correlation (r=0.95) was found between reference tests and tests performed from a distance of a few centimetres with the new sensor. As proof-of-principle of unobtrusive breath testing we have now shown detection of normal human mouth and nose breathing, and artificial gas pulses containing alcohol from a distance over 60 cm in a vehicle compartment.

Future
To improve sampling of the driver's breath, future work focuses on optimised signal acquisition and selection of positions within the vehicle compartment. Present challenges and important input to this work will be the influence from external air flows (ventilation), difference in breathing pattern (mouth/nose), passengers, and e.g. wind shield fluid. The sensor also provides possibilities to other applications, e.g. for access and passage control.

Introduction

To prevent drunk driving the police in many countries perform sobriety screening tests with use of breath analysers. In some countries the police are also entitled to perform evidential breath testing at the police station or even by the roadside. In addition to screening, installation of alcohol ignition interlocks, so called alcolocks, is a preventive measure. The first alcolocks were introduced in the late 20th century for conditional withdrawal of driver's license for people sentenced for drunk driving. The preventive effects of alcolocks increase with their increased use as quality assurance of commercial transport services. Pioneering work was performed in Sweden, and according to the Swedish Public Transport Association, and the Swedish Transport Administration alcolocks are installed in approximately 60% of all taxis, 85% of public buses (The Swedish Public Transportation Association, 2013), in all cars used in driving schools, and in connection to key cabinets and passage systems at work places. Today an increased international activity is seen, e.g. Finland and France have taken significant actions towards mandatory alcolock implementation in commercial transport services. A breath testing procedure less obtrusive than today's is desirable to reach increased acceptance for general breath testing among drivers and professionals whose sobriety is of importance for a safe work environment. State-of-the-art alcolocks require a significant volume, often in the order of 0.7-1.2 l (CENELEC, 2007), forcibly expired in a mouthpiece. This requirement is related to the fact that the breath alcohol concentration (BrAC) increases with expired volume, Fig 1. The increase over time is the result of continuous interaction between the breath and the mucous membrane of the airways (Wright et al., 1975, p. 208, George et al., 1993, p. 2444).

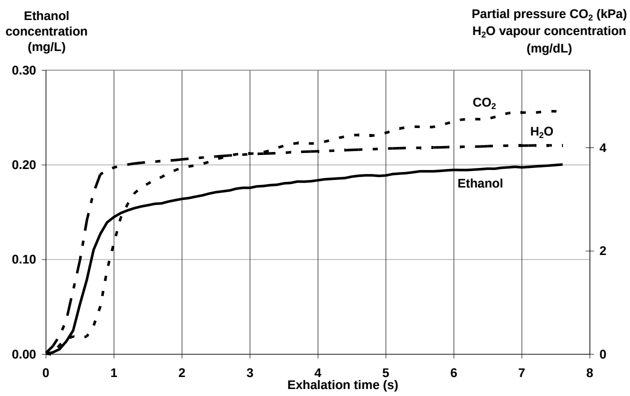

Figure 1. Expirogram illustrating the order of appearance and increase of water (H_20), ethanol, and carbon dioxide (CO_2) concentrations over time. Recorded with a modified Evidenzer instrument (Nanopuls AB, Sweden) (Kaisdotter Andersson et al., 2009, p.5-6).

Aim

The aim was to develop a breath alcohol analyser enabling fast, simple contact free breath testing with less physical effort. The sensor should meet the automotive industry's requirements of long-time stability, and short start-up and response time, regardless of the ambient temperature. The long term goal is extensive implementation of an in-vehicle integrated unobtrusive alcohol detection system.

Method

For achievement of proof-of-concept, extensive interdisciplinary verification tests are being undertaken. Under the leadership of Autoliv, SenseAir is responsible for design and verification of the gas sensor. Hök Instruments is responsible for the clinical human studies related to respiratory physiology, and the human-machine interface. Hök Instrument also performs verification tests of the sensor performance through experimental bench test set-ups, and in-vehicle tests.

Results

The validity of using carbon dioxide as a tracer gas

The method of using CO_2 as a tracer gas relies on two assumptions, which have been investigated and verified. The first is that similarities exist in the expirograms for ethanol and CO_2, during normal and provocative breathing pattern (Kaisdotter Andersson et al. 2009, p. 4; Kaisdotter Andersson et al, 2011, p. 54). The second assumption, that the end-expiratory

pCO_2 can be considered to be a constant, has been found valid after verification of small intra and inter individual variations in end-expiratory pCO_2 in healthy subjects (n=21, pCO_2 4.4±0.5 kPa), and subjects with respiratory impairment (n=9, pCO_2 3.9±0.7 kPa) (Kaisdotter Andersson et al., 2009, p. 4). The later appearance and the slower relative increase in concentration of CO_2, as compared to the ethanol (Fig. 1), make CO_2 a suitable quality indicator of the breath sample. Besides enabling reliable breath testing in smaller exhaled volumes simultaneous real-time measurement of CO_2 can be used to determine the fraction of breath in a diluted air sample.

From a diluted breath sample the BrAC valid for an undiluted breath sample can be estimated with equation (1):

$$BrAC = AC_{measured} * ((CO2_{end\text{-}expiratory} - CO2_{background})/(CO2_{measured} - CO2_{background})) \qquad (1)$$

BrAC= BrAC in undiluted sample; $AC_{measured}$ = alcohol concentration measured in diluted sample; $CO2_{end\text{-}expiratory}$ = constant assumed for CO_2 in end-expiratory (undiluted) sample (4.8 kPa (4.8 vol%); $CO2_{background}$= background level of CO2 measured before test; $CO2_{measured}$ = CO_2 measured in diluted sample.

Although the effect of elevated background level of CO_2 is not extensive in normal ambient air (CO_2 ~0.04 vol%, 0.8% of the end-expiratory CO_2), nor in closed compartments with good in-door air quality (~0.1 vol%, 2% of the end-expiratory CO_2) the factor of dilution is calculated with respect to the measured background level of CO_2.

The non-dispersive infrared gas sensor

The new gas sensor based on non-dispersive infra-red (NDIR) technology enables measurement of both expired alcohol and CO_2. Based on the principles established by White [White, 1942] SenseAir has developed a highly sensitive alcohol sensor, with a long optical path length within small physical dimensions. The small dimensions are advantageous for integration, and the small volume of the cavity does not add unnecessary dead volume to the breath sensor. With detectors designed for measurement of breath alcohol and CO_2 at approximately 9.5 µm and 4.26 µm, respectively, the sensor has shown high specificity and sensitivity, and fulfils the alcolock standard requirements of cross sensitivity in the (CENELEC, 2007). A housing for handheld use has been designed, Fig 2.

Figure 2. A prototype of the handheld breath alcohol analyser designed for directed breath.

The performance of the new sensor has been evaluated through controlled drinking studies. Fig 3 illustrates the relationship between the BrAC measured in undiluted breath with a reference instrument and the BrAC estimated from the measured concentration of ethanol and

CO_2 in a diluted breath. The breath tests were performed a few centimetres from the inlet of the hand held prototype, see Fig 2, resulting in a dilution factor of less than 2.5.

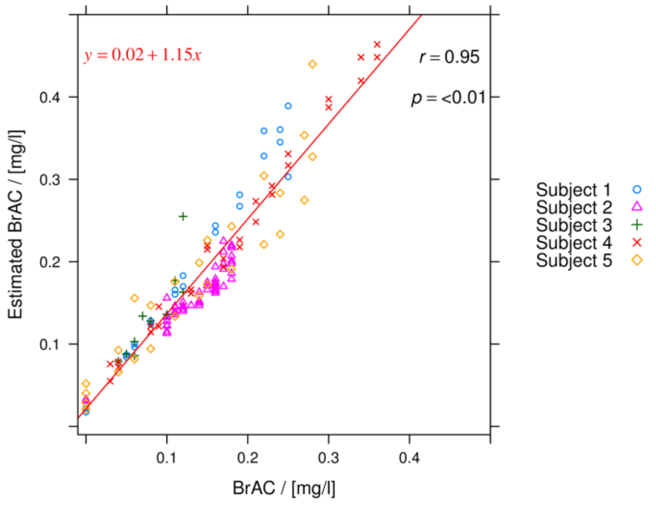

Figure 3. A strong correlation (r=0.95) has been found between the breath alcohol concentration (BrAC) measured with a reference instrument (FST, Intoximeters Inc.,US) and the BrAC estimated from diluted breath samples (subjects: n=5, breath tests n=143).

Unobtrusive breath testing/In-vehicle integration and testing

The dilution affects the BrAC measurement accuracy and for unobtrusive testing in the vehicle compartment the distance between driver and sensor will be critical. The relationship between the dilution of ethanol and CO_2 and how it depends on the distance can be seen in Fig 4. Dilution factors between 3 and 20 are attained for the distances 10, 20 and 30 cm. At 40 cm the dilution factor increases, and exhibiting large variations.

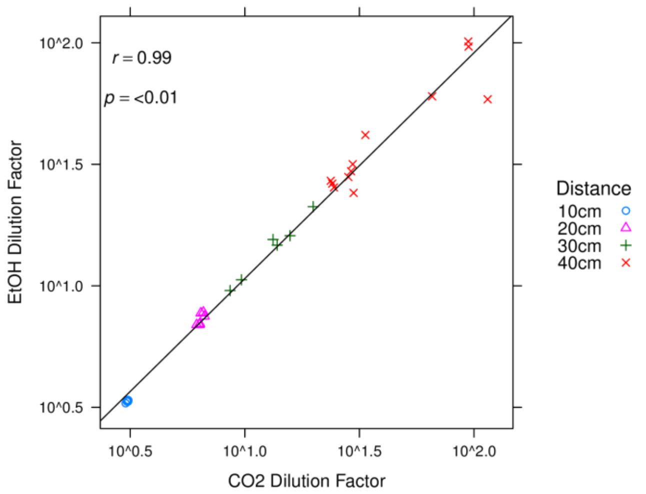

Figure 4. Log-log correlation of ethanol and CO_2 dilution, measured at a distance of 10-40 cm (n=30). The correlation can be seen over the distances but also in the random variation within the larger distances. The gas pulses had an ethanol concentration of 0.4 mg/l and 5 vol% CO_2 and were delivered with a total volume of 0.6 l during 2 sec.

After establishing with bench-tests that breath detection is feasible over longer distances in-vehicle test were performed, Fig 5(a). Fig 5(b) present how the ethanol and CO_2 signals correlate, during ten consecutive gas pulses delivered from a distance of 65 cm.

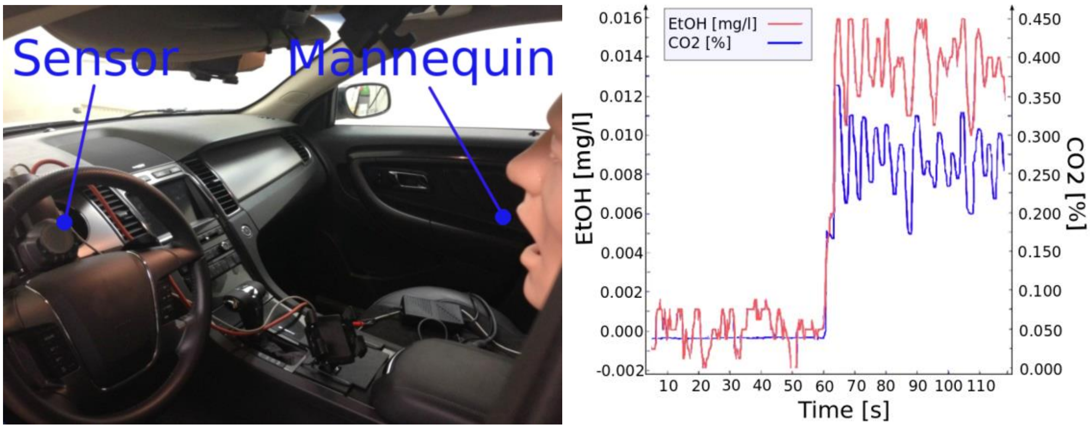

Figure 5. (a) Experimental setup in a vehicle compartment for investigations of the feasibility of unobtrusive testing. The sensor was located at the steering wheel and gas pulses were generated from a mannequin 65 cm from the sensor. (b) Recording of ten consecutive gas pulses starting at 60 seconds. The gas pulses contained 0.4 mg/l ethanol and 5 vol% CO_2, and had a total volume of 0.5 l during 2 sec, which is representative of human breathing at rest.

Combinations of in-vehicle sensor positions and human nose and mouth breathing are presently being studied. Placing the sensor on the steering wheel, as in Fig 5, appears to be one of the best positions for detection of mouth breathing. Fig 6 shows the measured CO_2 signal during an entering procedure. The set-up with artificial gas pulses, where ethanol was simultaneously detected, as well as the human normal breathing show a dilution factor of less than 20.

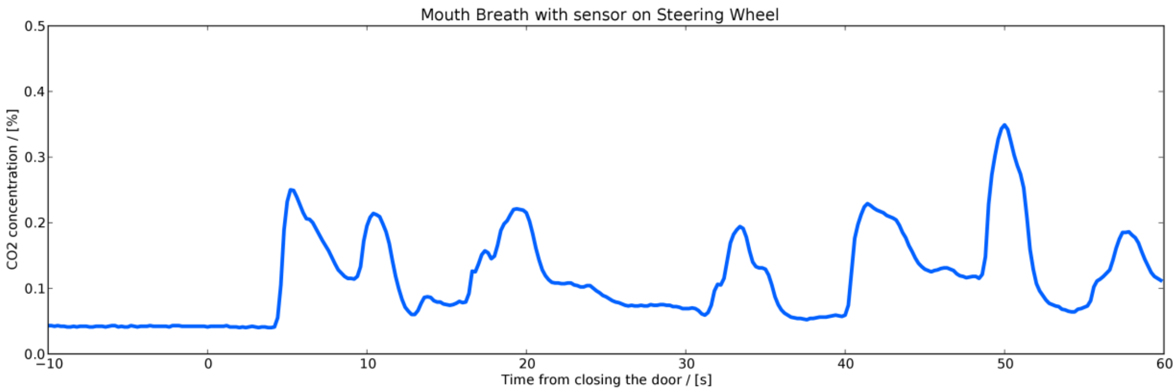

Figure 6. Recording of a test subject breathing normally through the mouth during an entrance procedure. The sensor is positioned near the steering wheel as shown in Fig 5.

Discussion/Future work

With a new gas sensor, proof-of-principle has been obtained for unobtrusive breath testing by measurements with artificial gas pulses in bench tests, and in a vehicle compartment with artificial pulses from a distance of 60 centimetres, and also with human subjects. With use of CO_2 as a tracer gas the correlation to human breath is secured and the factor of dilution is determined and used for estimation of the BrAC in undiluted breath according to eq. (1). To minimise the influence from background variations in CO_2 a breath sampling ensuring a dilution factor of less than 20 is desirable. The results from our in-vehicle test indicate that this is possible to attain.To further optimise sampling of the driver's breath, future work focuses on optimised signal acquisition and selection of positions within the vehicle compartment. Important input to this work will be the influence from external air flows (ventilation), difference in breathing pattern (mouth/nose), passengers, and e.g. wind shield fluid. The sensor also provides new possibilities to applications outside prevention of drunk driving, e.g. for access control and other screening applications.

Acknowledgment

We are grateful for the contributions from our colleagues and partners, especially Jonas Ljungblad and Mathias Granstam at Hök Instrument and Henrik Rödjegård and Hans Martin at SenseAir.

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Improving standards for case-control studies[1]

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Abstract

Between 2007 and 2010, six case-control studies were conducted within the European research-project DRUID to estimate the relative risk of serious injury for psychoactive substance use. Guidelines and study protocols were prepared for the DRUID-case-control studies according to the ICADTS guidelines for epidemiological studies (Walsh et al., 2008)(Walsh et al., 2008) to stimulate that the outcomes of these case-control studies were comparable. Furthermore, equivalent cut-offs were applied to adjust for differences between studies that collected information on recent substance use by means of oral fluid samples and by studies that used blood samples. Despite the high comparability of the study designs the results still showed large variations between the calculated odds ratios.

It is assumed that these differences were likely to be caused by several kinds of random and systematic errors. To investigate this assumption an in-depth study on eleven indicators of potential study errors was conducted on the results of the six DRUID case-control studies on injury risk.

The most commonly detected types of errors were selection bias and lack of sufficient study power due to small sample size. These differences seem to explain the majority of the variance between the calculated odds ratios.

In order to avoid bias and confounding due to errors, future guidelines are recommended to more systematically include an overview of the sources of potential bias and instructions of how to avoid them. Furthermore, a-priori assessments on potential bias could reduce the effect of random and specific errors.

By increasing the comparability of study designs and decreasing the potential errors of case-control studies a good estimate of the risk of driving under the influence of psychoactive substances might be available in future.

Background

Between 2006 and 2010 six population based case-control studies were conducted during the European research-project DRUID (DRiving Under the Influence of Drugs, Alcohol and Medicines) in order to determine the risk of being seriously injured while driving with psychoactive substances (Hels et al., 2011). These case-control studies were performed in Belgium (BE), Denmark (DK), Finland (FI), Italy (IT), Lithuania (LT) and the Netherlands (NL). All six studies were screened for the same 23 substances applying uniform analytical cut-off levels. Cases were seriously injured drivers admitted to hospitals after a traffic crash and controls were randomly selected drivers from the general traffic. In epidemiological research, case-control studies are used to compare determinants (e.g. the presence of drugs) between injured and non-injured drivers. The main outcome measure of case-control studies

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[1] This paper is based on the following article: Houwing, S., Hagenzieker, M., Mathijssen, M.P.M., Legrand, S.-A., Verstraete, A. G., Hels, T., Bernhoft, I.M., Simonsen, K.W., Lillesunde, P., Favretto, D., Ferrara, D., Caplinskiene, M., Movig, K. & Brookhuis, K.A. *Random and systematic errors in case-control studies calculating the injury risk of driving under the influence of psychoactive substances*. This article is published online in Accident Analysis and Prevention (AAP) 2013; doi: 10.1016/j.aap.2012.12.034.

is the odds ratio, which estimates relative risk, since relative risk calculations cannot always be used (Schmidt and Kohlmann, 2008).

The results from the DRUID case-control studies showed large variations in the relative risks for driving under the influence of psychoactive substances. The differences between the odds ratios of the case-control studies could reflect actual differences in relative risk for driving under the influence in the different countries. However, it is hard to believe that drivers in different countries show such large differences for the relative risk of serious injury while driving under the influence of psychoactive substances. Therefore, the observed differences between the odds ratios could also be at least partially explained by several types of errors.

Aims

The main objective of this study is to provide insight in the different types of errors that could explain the variance in the results of the six DRUID case-control studies. The results of this assessment may clarify the large inter-country variation that was observed between the odds ratios.

Methods

In epidemiological literature different types of categorisations of bias exist. In this study we used the classifications of Kleinbaum et al. (1982) and Rothman (1986) who distinguish three main types of bias: selection bias, information bias and confounding. This categorization is supported by Wacholder et al. (1992) who wrote two companion papers on issues involved in selecting controls for case-control studies. They state that the selection of controls should be comparable to the selection of cases in three ways: the study base should be the same, confounding factors should be used to eliminate any distortion by other factors, and the measurement errors should be comparable. These principles should reduce the three previously mentioned types of bias in case-control studies: selection bias, information bias and confounding. However, they also state that the effectiveness of these principles is constrained by the availability of resources and time.

Information was gathered for each of the potential indicators from the relevant DRUID reports on prevalence (Houwing et al., 2011; Isalberti et al., 2011) and risk estimates (Hels et al., 2011). These prevalence reports included the national reports for the six participating countries, which provided detailed information concerning the hospital studies and the roadside surveys.

Table 1. Indicators of potential errors.

Type of error	Type of bias	Indicator	Short explanation
Random error		Sample size	Influences accuracy
		Low cell counts	Low frequency in a cell leads to less accurate odds ratios
Systematic error	Selection bias	Geographic area covered by cases and controls	Difference in area covered when sampling cases and controls may result in bias
		Size of non-response	Large non-response may result in larger bias
		Age and gender distribution of response and non-response group	Differences may indicate non-response bias
		Non-random sampling	Over representation of specific groups may lead to bias
		Injury scale	Differences in inclusion criteria may lead to incomparable case populations
	Information bias	Sampling method cases and controls	Different sampling methods in cases and controls may lead to bias
		Analytical method	Differences in sensitivity of the methods of analysis may lead to bias
		Time between accident and sampling	Differences in time between accident and sampling may lead to bias
	Confounding	Confounding factors controlled for	Control for different confounding factors may lead to bias

Finally, the collected information from the DRUID reports was used to interpret the calculated odds ratios. A quantitative assessment of bias was not possible, since this would require a large amount of detailed data on e.g. the use of psychoactive substances in the general population for each study region, which were not available. Therefore, in this study bias is only discussed in qualitative terms based on the information derived from the reports on the prevalence and risk studies by searching for deviations between the six studies on each of the indicators.

Results

Random errors were indicated by an assessment on sample size and on low cell counts. The sample size is the number (*n*) of individual samples in a study. The precision and thus statistical power of a study increases with the sample size. The sample size for the hospital cases varied between 54 for the Finnish study and 839 for the Danish study. The sample size of the control samples which were collected at the roadside ranged between 1,086 for the Italian study and 4,822 for the Dutch study. Only the Belgian and the Danish study included relatively high number of samples in both the case (BE:348 and DK:839) and the control populations (BE: 2,949 and DK:3,002) (Houwing et al., 2011; Isalberti et al., 2011).

In addition to the total sample size, the distribution of the samples over the four cells in a case-control study provides valuable information on the accuracy of the outcomes as well. In the report on risk estimates (Hels et al., 2011) the issue of low cell counts was explored by an alternative method to calculate overall odds ratios. The results of this analysis on low cell counts showed low cell counts for all substances in the Finnish case-control study. The Lithuanian, Italian and Dutch study each had sufficient cell counts for three of the substance groups only. In Denmark and Belgium the results of the case-control study seemed to have the highest accuracy with sufficient cell counts for five and six substance groups, respectively.

Based on the assessment on random errors it may be concluded that all studies have been subject to random errors. The Belgian and Danish studies were considered to have the highest study power and thus the largest precision. Both studies were also the only studies that were regarded as having a sufficiently large sample size of both cases and controls.

Systematic errors were indicated by an assessment on selection bias, information bias, and confounding. For selection bias an assessment was made on five different indicators: the geographical coverage by cases and controls, size of non-response, gender and age differences between the response and non-response group, non-random sampling and differences in injury scale. The geographical coverage by cases and controls and differences in injury scale did not seem to have resulted in large bias. However, the size of non-response in the roadside surveys showed large variations with a range of between 0 and 52%. In Italy, non-response was non-existent since participation was mandatory. In Lithuania, Belgium and Finland the proportion of non-respondents at the roadside was very high at 25%, 48% and 52%, respectively. Based on this information, we assess that there was likely to be an overestimation of the odds ratios for illicit drugs in these three countries.

The assessment on age and gender distribution indicate an under representation of illicit drug use by car drivers in Belgium and Finland, due to a higher share of young male drivers in the non-response group of the roadside surveys. Differences were detected in Denmark and the Netherlands as well, but since the total non-response rate was relatively low the effect is likely to be small. In Lithuania, it may be assumed that due to the over representation of female drivers in the non-response group the prevalence of illicit drugs in traffic is overestimated whereas the prevalence of medicinal drugs is underestimated. In Italy no non-response was observed in either the hospital study or the roadside survey.

The process of random sampling can be endangered by detection bias. Detection bias is a form of selection bias, which can occur due to oversampling of certain sub-populations. The presence of detection bias is hard to reveal. However, in the DRUID report on the case-control studies (Hels et al., 2011) it was noted, based on personal communication with the Italian researchers, that in the Italian roadside survey drivers who showed clinical signs of alcohol impairment had partially been preselected. Therefore, alcohol use in Italian traffic is expected to be overestimated, causing an underestimation of the odds ratios for alcohol use. This detection bias may also have been present for users of psychoactive substances other than alcohol, in the event that they showed signs of impairment as well. We assess that the Italian odds ratios for alcohol and other psychoactive substances were likely to be underestimated. For all other countries no indication was found for bias due to non-random sampling.

Information bias may be indicated by differences in sampling methods between the cases and the controls, by differences in the analytical methods and by differences in the time between accident and sampling between the national DRUID case-control studies. According to the assessment on these indicators we assume only a small likelihood of the presence of information bias. This likelihood is mainly in present in the Dutch and Danish study in which respectively, another collection method for oral fluid sampling and another injury coding method were used. The likelihood of information bias was mainly limited because of a priori agreements on a uniform study design and because of applying equivalent cut-offs between blood and oral fluid concentrations were used in order to be able to compare blood and oral fluid concentrations (Verstraete et al., 2011). Furthermore, four separate rounds of proficiency testing were performed. The results of the proficiency testing show that both qualitative and quantitative performance improved during the testing program (Pil et al., 2010). Therefore, bias due to differences in the analytical methods is not likely.

Deconfounding is, like the presence of an identical study base for both cases and controls, one of the main principles of comparative case and control selections (Wacholder et al., 1992). Confounding factors are variables that co-vary both with substance use and crash risk. Taking into account different types of confounding factors can cause variation between the results of case-control studies. In the DRUID project all the case-control studies' results were calculated by the Technical University of Denmark (DTU), ensuring a uniform method of statistical analysis. The results of all countries were based on a similar set of variables (age and gender). Furthermore, the data from all six roadside surveys were weighted for the volume of traffic flow in the different time periods. There are probably other confounding factors that were not detected in these studies. Age and gender were included as confounding variables in all calculations and since the data were adjusted for differences in traffic volume between time periods, and therefore we assume that the potential effect of confounding has been reduced. However, since confounding has only been eliminated for those factors that we had data available for, any influence of confounding on the estimated odds ratios cannot be ruled out.

Discussion and conclusions

It is clear from the results of this study that the presence of uniform guidelines was not sufficient in excluding differences in the design and protocol of the six national DRUID case-control studies. Deviations from the guidelines such as those mentioned in the present study were caused by practical, financial and legal limitations. Such limitations are difficult to overcome for researchers. Therefore, it would be utopic to expect that future studies will be fully comparable with each other.

The results of this study reflect the importance for future review studies or meta-analyses of epidemiological studies that estimate the risk of driving under the influence of psychoactive substances to include assessments of potential errors. These assessments are essential for better understanding the relationship between observed and actual risk estimations. Furthermore, we advise that future case-control studies in the field of driving under the influence include a pilot study with an assessment on potential bias. This would allow identification of the presence of potential limitations in the study design that could result in bias. The list of potential indicators that was used in this study could be used as a guidance, as long as it is kept in mind that this list is tailored to the DRUID case-control studies. Therefore, including additional variables in this list might be necessary. Finally, an a priori calculation of sample size could provide valuable information in how to maximize the precision of the study given certain limitations regarding resources and time. The most commonly detected types of errors were selection bias and lack of sufficient study power due to small sample size. These differences seem to explain the larger part of the variance between the calculated odds ratios.

By increasing the comparability of study designs and decreasing the potential errors of case-control studies a good estimate of the risk of driving under the influence of psychoactive substances might be available in future.

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The use of psychoactive substances in European traffic: results from the European DRUID-project.

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Abstract
Between 2006 and 2011 a large scale research project named DRUID (Driving Under the Influence of Drugs, Alcohol and Medicines) was conducted to provide scientific knowledge for combating driving under the influence of psychoactive substances in the European Member States. As part of this DRUID-project roadside surveys have been conducted in thirteen European countries to get more insight in the use of psychoactive substances among drivers in traffic. Information on recent substance use was obtained by collecting blood and oral fluid samples from almost 50.000 randomly selected car drivers. The results show that alcohol is the number one psychoactive substance on European roads, followed by illicit drugs and medicinal drugs. Illicit drugs were mainly detected among young male drivers, during all times of the day, but mainly in the weekend. Medicinal drugs such as benzodiazepines and Z-drugs were mainly detected among older female drivers during daytime hours. The use of substances among drivers in the general driving population in Europe varies largely per country, but general patterns can be distinguished on the level of European regions:

1. Z-drugs and medicinal opiates and opioids were in general relatively frequently detected in Northern European countries.
2. Illicit drugs, alcohol and benzodiazepines were relatively frequently detected in Southern European countries.
3. In Eastern Europe the prevalence of alcohol and illicit drugs was relatively low compared to the other European regions.
4. In Western Europe, substance use was more or less on the European average.

The results show that drug use in traffic varies per country. Therefore, a European set of countermeasures might not be as effective as national countermeasures, which are in general more designed to the country specific issues on driving under the influence.

Background

In 2001, approximately 54,000 road users were killed in traffic accidents within the European Union. To decrease the number of traffic fatalities the European Commission formulated road safety targets (Commission of the European Communities, 2001). The target for 2010 was set at 27,000: a 50% decrease of the number of fatalities in European traffic as compared to 2001. By the end of 2010, the total number of road fatalities was nearly 31,000 which comes down to a 43% reduction (ETSC, 2011). Despite the fact that the decrease of road fatalities did not meet the 50% target reduction, a new ambitious road safety target was formulated for the period 2011-2020 which again included a 50% decrease of the number of traffic fatalities in a period of ten year. The aim of the 2020 road safety target was set at a maximum number of 15,500 traffic fatalities (European Commission, 2010).

It is generally known that using psychoactive substances (such as alcohol and drugs) impairs driving skills resulting in higher relative risks of being involved in a road crash (Beirness et al., 2006; Brault et al., 2004; Compton et al., 2002; Drummer et al., 2004; Hels et al., 2011; Kelly et al., 2004; Krüger & Vollrath, 2004; Mathijssen & Houwing, 2005; Mura et al., 2003;

Ramaekers et al., 2004; Walsh et al., 2004). The European Commission acknowledged the negative effect of substance use on traffic safety and granted a proposal of the DRUID consortium (DRiving Under the Influence of Drugs, alcohol and medicines) within the 6th EU Framework Programme (2002-2006) for conducting research into the prevalence and effects of driving under the influence and its countermeasures with the ultimate aim to decrease the number of traffic fatalities as a result of driving under the influence. The DRUID-project was conducted between 2006 and 2011 and its main target was to provide scientific support to the EU transport policy to reach the road safety targets by establishing guidelines and measures to combat impaired driving (DRUID, 2012). The DRUID project covered different topics such as impairment, prevalence, risk, enforcement, classification of medicines, countermeasures, dissemination and guidelines. By combining the knowledge from different scientific fields a new approach could be developed to help reduce the number of alcohol and drug impaired traffic fatalities.

Aims

One of the main aims of the DRUID-project was to get more insight in the use of psychoactive substances among drivers in European traffic.

Methods

Participants, i.e. drivers of passenger cars and vans, were randomly selected using a stratified multi-stage sampling design. In the first stage, one or more regions per country were selected. These regions were meant to be representative for the country with regard to substance use and traffic distribution. Within the selected regions smaller research areas were selected, and within these areas, survey locations were selected, where subjects were stopped at random, and were requested to participate in the study. With regard to days of the week and times of the day, the study population sample was stratified into eight time periods over the week, for each of the survey areas. The time periods did not overlap each other and covered all the days of the week and all times of the day. Blood and oral fluid samples were collected from participating drivers. Oral fluid samples were collected by StatSure Saliva Sampler devices for saliva collection, except for the Netherlands, where saliva was collected by means of ordinary spit cups. Blood samples were collected in four out of the thirteen countries (Belgium, Italy, the Netherlands and Lithuania). All four countries used glass tubes for the collection containing sodium fluoride and potassium oxalate.

Extraction of the substances was based on liquid-liquid (LLE) or solid phase (SPE), chromatographic separation was performed by gas chromatography (GC) or Liquid chromatography (LC), detection was done by mass spectrometry.

In total 23 substances have been included in the core substance list at the beginning of the project. The list of core substances was based on the prevalence of use in the general population and their possible influence on driving ability. For each substance an analytical cut-off has been selected based on the lowest limit of quantitation (LOQ) that could be measured by all toxicological laboratories that were involved in the analysis of the substances. LOQ's reflect the lowest concentrations for substances at which quantitative results can be reported with a high degree of confidence. For the final results presented in this paper, equivalent cut-offs, and not the LOQ's, are used for analysis of the core substances to correct for differences in concentrations of substances in blood and in saliva (see table 1).

Table 1. Applied cut-offs for psychoactive substances other than alcohol; THC-COOH is not included in this table since THC-COOH was not analysed in oral fluid.

Substance	Cut-off in oral fluid (ng/mL)	Cut-off in whole blood (ng/mL)	Substance group
Amphetamine	360	20	Amphetamines
Methamphetamine	410	20	
MDA	220	20	
MDEA	270	20	
MDMA	270	20	
Cocaine	170	10	Cocaine
Benzoylecgonine	95	50	
THC	27	1.0	Cannabis
6-Acetylmorphine	16	10	Illicit opiates
Diazepam	5.0	140	Benzodiazepines
Flunitrazepam	1.0	5.3	
Lorazepam	1.1	10	
Alprazolam	3.5	10	
Clonazepam	1.7	10	
Nordiazepam	1.1	20	
Oxazepam	13	50	
Methadone	22	10	Medicinal opioids
Morphine	95	10	Medicinal opioids or illicit opiates
Codeine	94	10	
Zolpidem	10	37	Z-drugs
Zopiclone	25	10	

The distribution of the study population sample by time periods was not proportionate to the distribution of the general driving population over these periods. This was unavoidable since in many of the thirteen countries the researchers had to take into account the preferences of the police who were needed to stop the drivers from moving traffic. Weight factors were applied to correct for this disproportion based on the ratio by time period between the distribution of traffic and the distribution of the participants.

Results

Information on recent substance use was obtained by collecting blood and oral fluid samples from almost 50.000 randomly selected car drivers (Houwing et al., 2011). Table 2 provides an overview of the main results per substance group, both per country as well as the estimated mean for Europe. The European mean can be used to distinguish per substance whether a country prevalence is around, below or above this European mean. The table presents the spread of the prevalence around the estimated European mean. A yellow colour of a particular prevalence value indicates that the European mean lies within the 95% confidence interval of the prevalence. A green coloured value indicates that the confidence interval suggests that it is below the European mean, and a red coloured value indicates that the confidence interval suggests that it is above the European mean.

Table 2. Overview of the estimated European prevalences of psychoactive substances; prevalences in percentage; 95% confidence intervals in italics.

		Inhabitants (million)	negative	amphetamines	cocaine	THC	illicit opiates	benzodiazepines	Z-drugs	medicinal opiates and opioids	alcohol	alcohol-drugs	drugs-drugs
Northern Europe	DK	5.4	95.52	0.02	-	0.2	-	0.47	0.32	0.79	2.53	0.1	0.06
			94.72 - 96.2	*0 - 0.16*	-	*0.09 - 0.43*	-	*0.28 - 0.79*	*0.17 - 0.59*	*0.53 - 1.18*	*2.02 - 3.15*	*0.03 - 0.3*	*0.02 - 0.24*
	FI	5.3	97.15	0.05	0.03	0.04	-	0.79	0.36	0.56	0.64	0.08	0.29
			96.58 - 97.63	*0.02 - 0.19*	*0.01 - 0.16*	*0.01 - 0.17*	-	*0.56 - 1.13*	*0.21 - 0.6*	*0.37 - 0.85*	*0.43 - 0.94*	*0.03 - 0.23*	*0.16 - 0.52*
	NO	4.7	97.03	0.06	0.06	0.48	-	0.84	0.69	0.16	0.32	0.07	0.28
			96.67 - 97.36	*0.02 - 0.13*	*0.03 - 0.14*	*0.36 - 0.64*	-	*0.67 - 1.05*	*0.54 - 0.88*	*0.1 - 0.27*	*0.23 - 0.46*	*0.03 - 0.15*	*0.19 - 0.42*
	SE	9.1	98.66	0.07	-	0.03	-	0.19	0.31	0.63	NA	NA	0.12
			98.34 - 98.92	*0.03 - 0.17*	-	*0.01 - 0.12*	-	*0.11 - 0.33*	*0.2 - 0.48*	*0.46 - 0.86*			*0.06 - 0.25*
	Total N-EU	*93.3*	*97.32*	*0.05*	*0.02*	*0.16*	*0.00*	*0.51*	*0.40*	*0.56*	*1.20*	*0.05*	*0.17*
Eastern Europe	CZ	10.3	97.2	0.36	-	0.46	-	0.62	-	0.21	0.99	0.05	0.11
			96.39 - 97.83	*0.17 - 0.72*	-	*0.25 - 0.86*	-	*0.36 - 1.07*	-	*0.08 - 0.52*	*0.65 - 1.53*	*0.01 - 0.28*	*0.03 - 0.38*
	HU	10.1	97.68	-	0.04	0.19	-	1.5	0.07	0.11	0.15	-	0.27
			97.04 - 98.18	-	*0.01 - 0.21*	*0.08 - 0.44*	-	*1.11 - 2.03*	*0.02 - 0.26*	*0.04 - 0.32*	*0.06 - 0.38*	-	*0.13 - 0.54*
	LT	3.4	94.49	0.22	-	-	-	1.41	-	-	3.86	0.03	-
			93.09 - 95.61	0.07 - 0.66	-	-	-	0.9 - 2.23	-	-	2.93 - 5.06	0 - 0.36	-
	PL	38.2	97.63	0.05	-	0.57	0.09	0.14	-	0.03	1.47	-	0.02
			97.11 - 98.05	*0.01 - 0.18*	-	*0.38 - 0.85*	*0.04 - 0.25*	*0.06 - 0.31*	-	*0.01 - 0.15*	*1.14 - 1.9*	-	*0 - 0.14*
	Total E-EU	*96.7*	*97.57*	*0.09*	*0.01*	*0.47*	*0.06*	*0.52*	*0.02*	*0.08*	*1.10*	*0.01*	*0.07*
Southern Europe	ES	44.5	85.15	0.11	1.49	5.99	0.05	1.4	-	0.19	3.92	1.14	0.57
			83.87 - 86.34	*0.04 - 0.3*	*1.12 - 1.97*	*5.22 - 6.87*	*0.01 - 0.2*	*1.05 - 1.87*	-	*0.09 - 0.41*	*3.3 - 4.66*	*0.83 - 1.58*	*0.36 - 0.89*
	IT	59.1	84.99	-	1.25	1.15	0.3	0.97	-	0.53	8.59	1.01	1.22
			82.95 - 86.82	-	*0.78 - 2.01*	*0.7 - 1.89*	*0.12 - 0.78*	*0.57 - 1.67*	-	*0.25 - 1.09*	*7.19 - 10.23*	*0.59 - 1.71*	*0.75 - 1.97*
	PT	10.6	90.01	-	0.03	1.38	0.15	2.73	-	0.11	4.93	0.42	0.23
			89.04 - 90.91	-	*0.01 - 0.16*	*1.07 - 1.8*	*0.07 - 0.33*	*2.27 - 3.29*	-	*0.04 - 0.27*	*4.29 - 5.64*	*0.26 - 0.67*	*0.12 - 0.44*
	Total S-EU	*128.6*	*85.52*	*0.04*	*1.23*	*3.06*	*0.19*	*1.30*	*0.00*	*0.36*	*6.43*	*1.01*	*0.87*
Western Europe	BE	10.6	89.35	-	0.2	0.35	0.09	2.01	0.22	0.75	6.42	0.31	0.3
			88.18 - 90.41	-	*0.09 - 0.43*	*0.19 - 0.64*	*0.03 - 0.28*	*1.57 - 2.59*	*0.1 - 0.47*	*0.5 - 1.13*	*5.59 - 7.36*	*0.16 - 0.58*	*0.16 - 0.58*
	NL	16.4	94.49	0.19	0.3	1.67	0.01	0.4	0.04	0.16	2.15	0.24	0.35
			93.81 - 95.1	*0.1 - 0.36*	*0.18 - 0.5*	*1.34 - 2.07*	*0 - 0.09*	*0.25 - 0.62*	*0.01 - 0.15*	*0.08 - 0.32*	*1.78 - 2.6*	*0.13 - 0.42*	*0.22 - 0.56*
	Total W-EU	*181.4*	*92.46*	*0.12*	*0.26*	*1.15*	*0.04*	*1.03*	*0.11*	*0.39*	*3.83*	*0.27*	*0.33*
Weighted European mean		***500.0***	***92.57***	***0.08***	***0.42***	***1.32***	***0.07***	***0.90***	***0.12***	***0.35***	***3.48***	***0.37***	***0.39***

Alcohol is still by far the number one psychoactive substance on European roads, followed by illicit drugs and medicinal drugs. On a European level alcohol is estimated to be used by 3.48% of the drivers, illicit drugs by 1.90% of the drivers, medicinal drugs by 1.36% of the drivers, drug-drug combinations by 0.39% of the drivers and alcohol-drug combinations by 0.37% of the drivers.

For illicit drugs, THC is the most frequently detected drug in traffic, followed by cocaine. Amphetamines and illicit opiates were less frequently detected. Illicit drugs were in general mainly detected among young male drivers, during all times of the day but mainly in the weekend.

Medicinal drugs were in general mainly detected among older female drivers during daytime hours. Benzodiazepines were the most prevalent medicinal drug in traffic, Z-drugs were less prevalent. However, considerable differences between countries were present.

The use of substances among drivers in the general driving population in Europe (prevalence) varies very much per country, but general patterns can be distinguished on the level of European regions:

- o The medicinal drugs Z-drugs and medicinal opiates and opioids were in general relatively frequently detected in Northern European countries.
- o Illicit drugs, alcohol and benzodiazepines are relatively frequently detected in Southern European countries.
- o In Eastern Europe the prevalence of alcohol and drugs was relatively low compared to the other European regions.
- o In Western Europe, drug use is more or less on the European average.

Discussion and conclusions

This study provided information on the prevalence of different psychoactive substances in traffic in thirteen European countries. A uniform design was used which makes it possible to compare the results between the countries. By using equivalent cut-offs for drugs in blood and oral fluid, the limitation of the comparability of the results when including two different body fluid samples (blood and oral fluid) was overcome. A limitation of this study is that the list of analyzed substances was not exhaustive. For example, there was no screening for gamma-hydroxybutyric acid (GHB), only seven benzodiazepines were screened for, and selective serotonin reuptake inhibitors were not included. Furthermore, different kind of errors could have affected the results (see ICADTS paper "Improving standards for case-control studies").

The results of the DRUID prevalence studies show that drug use in traffic varies per country, although general patterns for European regions can be distinguished. Alcohol is the most frequently detected psychoactive substance in Europe followed by THC and benzodiazepines. These finding are in line with the results from the American national roadside survey of alcohol and drug use by drivers that was conducted in 2007 (Lacey et al., 2009), under the authority of the National Highway Traffic Safety Association (NHTSA). In the NHTSA study Alcohol, THC, cocaine and benzodiazepines were also the most frequently detected substances. Furthermore, both studies show that illicit substance use is more common among young male drivers and that the use of medicinal drugs is more common among older female drivers.

Since large differences in prevalence of psychoactive substances exist, a European set of countermeasures might not be as effective as national countermeasures, which are in general more designed to the country specific issues on driving under the influence.

Task 2.2.3 partners

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Intervention model on drink driving in Suzhou

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Introduction

Since 2010, Suzhou government starts the implementation of the road safety in China project, city actively learn from advanced foreign experience, focusing on the drink driving risk factors of the comprehensive intervention, and gradually established a "unified leadership of the government departments, synergistic, the masses consciously participate " the working mechanism, continuously expand the breadth and depth of social participation, the use of social marketing theory, the innovative research on the " Drink Safety Environment Restaurants " to create activities, improve the public awareness of traffic safety, to minimize the road traffic injury to drink driving, and achieved remarkable results. In 2012, Suzhou city was awarded health city for the best practice award by World Health Organization.

Strengthen organization and leadership, establish multi-sect oral coordination mechanism

Suzhou government attaches great importance to the project work, to ensure that the implementation of the project, set up a special composed of health, public security, propaganda, traffic, the Red Cross, finance and other departments of the leading group, the establishment of a joint meeting system, clear responsibilities of various departments and tasks.

Definite objectives, determine the program of work.

According to China's road safety overall project requirements, combined with the actual situation of Suzhou, Suzhou City Hall issued a "Suzhou city road safety project implementation plan (2012-2013)", the five tasks: one is to improve the regional project target population changes in the prevention of drink driving and speeding knowledge and behavior; two is to enhance the project area drink driving and speeding and strengthen the implementation of the level of law enforcement; three is to drink driving and speeding, development or enhance road safety legislation suitable; four is to improve the work of relevant institutions, including propaganda and improve road safety awareness, targeted interventions; five is to the supervision and evaluation of intervention effect. We selected Wuzhong District as a key intervention pilot area, in the area for drink driving behavior intervention in 2012.

Strengthen the ability construction; improve the skills of the law enforcement field.

We have given the law enforcement capacity building workshop, road safety traffic police training and police enforcement AC series, conflict, negotiation method to invite the international road safety experts on international duty police law enforcement and law enforcement process, introduces the management organization and the specific implementation of the strategy of international enforcement of traffic police, through on-site observation Suzhou police for speeding and driving under the influence and law enforcement, in-depth discussions and exchanges, has provided valuable suggestions to improve Suzhou traffic police law enforcement inspection, effectively raising the level of law enforcement field.

To strengthen law enforcement[1], effectively check drink driving behavior.

In accordance with the "overall leadership of the government, departmental interaction, social participation, comprehensive treatment" requirement, the city to promote traffic safety special rectification, effective measures to comprehensive supervision, the formation of the "good pattern of unified command, bar linkage, accountable, overall progress". To tie in with the work of the project, the traffic police department for the "drink driving" and "speeding" risk factors, project carried out in Suzhou city road safety enforcement hundred days of action, vigorously carry out the deterrent enforcement activities during the period, the major media in Suzhou participate in the entire process, key reports. By further strengthening law enforcement regulation, effectively check the illegal behaviour, to keep the traffic safety situation is generally stable.

Strengthen social propaganda[2], enhance the awareness of traffic safety.

One is the extensive media publicity. In 2012 September, the project office in Suzhou City, more than 40 media gathered in the municipal Party Committee Propaganda Department with the assistance of road safety project held a media conference. According to the publicity scheme, Suzhou TV prime-time broadcast who made to prevent drink driving public service announcements; Suzhou channel 104.8 aired by Jiang Wenli advocated "drink driving, extremely dangerous" public service ads; Suzhou city municipal management in urban trunk road outdoor electronic screen rolling broadcast advertisement; project office opened the establishment of Suzhou City, SMS platform, road safety net, and to carry out "drive not drink, drink please drive" as the theme of the campaign. Two is the use of various "day", "day" activities to improve the traffic safety awareness. Project office with traffic violation and accident characteristics, typical case selection, production of thematic promotional materials, the city's total printed flyers painting carried out extensive publicity in restaurants, bars, KTV, car wash shop, gas station, parking, illegal processing window etc.. Printed in 1000 copies of brochures, promotional calendar 500, distribute it to the project members. Three is to expand the project using the star effect. The famous movie star Jiang Wenli lady invited as project the image ambassador, recording Suzhou traffic radio feature programs, the first-line condolences to the police, to participate in road safety hundred days of action and road safety net opening ceremony, to attract volunteers, effectively improve the project social participation.

To create drink safety environment Restaurants, exploring new modes of intervention.

The project to develop ideas, build cooperation platform, the professional software company developing drink and drive software, the hotel - drive, advertising, media - insurance industry organic integration, form the standard drive service chain, strengthen the public "do not drink driving, not drinking and driving" consciousness and behavior. One is the hotel own declare become create unit. Commitment to actively participate in the hotel project work, create against drink driving publicity atmosphere, the establishment of advocacy volunteers, and drink and drive service. Two is to drive company providing standardized service. A qualified driving on behalf of company and hotel collaboration, drink and drive service for dinner to provide customers with safe, normative, reduce the possibility of drink driving. Three is advertising company to participate in. Advertising companies to develop trust publicity scheme drinking restaurant, guiding the creation units to carry out publicity atmosphere layout, unified propaganda content and style, and strive to produce maximum publicity effect. The four is the insurance company opened new categories. Aiming at the possible drink and drive the service process of the personal and property safety, risk, to drive company design a new insurance scheme, strengthen risk guarantee service. At present, the model runs smoothly, begun to take shape, has been recognized by the WHO and the Ministry of health

Conclusion

One is the initial establishment of injury intervention mechanism of multi-sectoral cooperation, under the unified leadership of the government, financial, health, public security, traffic, propaganda, education and other departments to integrate resources and responsibilities, collaboration, the formation of the "good atmosphere of government leading, departments, the whole society to participate "; two is the training of road safety project quality, change the road injury intervention idea, improve law enforcement skills, realize the change from passive management to active management, by monitoring into intervention, by accident into the accident prevention three changes, to further improve the effect of road injury intervention; three is through the implementation of the project, increase public awareness of traffic safety. Effectively reduce drink-driving violations, reduce drink driving and speeding accident injuries; four is to further expand the social marketing concept[3], in strengthening the propaganda, strengthen law enforcement on the basis of further exploration of "combination of sparse block" drink intervention social participation and new model, to create social marketing brand - " Drink Safety Environment Restaurants "; five is through the implementation of the road safety project, and further improve the our city injury intervention work ability, promotes the intervention to work.

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Automated and semi-automated screening, LCMSMS confirmation and human hepatocyte high-resolution metabolism studies of synthetic cannabinoids

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Abstract

Background
Designer drug availability changes rapidly. Assays are needed to identify synthetic cannabinoids in human urine, but metabolites are frequently unknown.

Aims
To evaluate available screen performance, develop sensitive and specific LCMSMS confirmation assays, and utilize human hepatocyte cultures and high-resolution (HR) mass spectrometry to identify unique urinary targets.

Methods
Homogeneous (Immunalysis), and heterogeneous (Randox; National Medical Services (NMS)) screening assays were evaluated with authentic urine specimens. An LCMSMS qualitative confirmation method for synthetic cannabinoids (JWH-018, JWH-073, JWH-081, JWH-122, JWH-200, JWH-210, JWH-250, AM 2201 and RCS-4) and 20 metabolites in human urine was developed. Specimens were hydrolyzed and protein precipitated, followed by single MRM transition monitoring or survey scan that triggered an enhanced product ion scan at 3 different collision energies on the ABSciex 5500 Qtrap.

Results
2500 specimens were screened by Randox, Immunalysis, NMS, and LCMSMS assays for 19 hydroxyalkyl, hydroxyindole and carboxy metabolites of 9 synthetic cannabinoids. Positive criteria included retention time, purity of fit, and presence of 3 ions, including the molecular ion. Confirmation based on full spectra increased identification confidence. 285 samples were LCMSMS positive for synthetic cannabinoids. Immunalysis and NMS assays had high sensitivities (87.7 and 84.9%) and specificities (98.7 and 97.7%) at a 5ng/mL cutoff; Randox identified almost all positive specimens (97.9% sensitivity), but had 1149 presumptive positive unconfirmed specimens (48.1% specificity). Possible reasons for low specificity, and advantages and disadvantages of approaches are discussed. Human hepatocyte cultures and HR mass spectrometry identified new synthetic cannabinoids metabolites to improve emerging drug identification.

Discussion and conclusion
Identification of new synthetic cannabinoids is a difficult and critical laboratory problem.

Qualitative confirmation is sufficient, as there are no legal cut-offs, and no known dose-effect-relationships, or detection windows after controlled administration. As human studies cannot be performed due to a lack of toxicity data, other approaches are needed.

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Introduction

Synthetic cannabinoids are cannabinoid CB_1 and/or CB_2 receptor ligands originally developed as pharmacological tools for investigating the endocannabinoid system or as potential pharmacotherapies. Hundreds of compounds were synthesized in academia and pharmaceutical companies, with binding affinities and structure-activity-relationships investigated (Huffman, 1999; Makriyannis and Deng, 2001). In contrast to Δ9-tetrahydrocannabinol (THC), which is the primary psychoactive compound in *Cannabis* and a partial agonist at both receptors, synthetic cannabinoids may be full agonists and selective for one receptor subtype, or similar to THC, active at both. Synthetic cannabinoids are now major illicit designer drugs that are deceptively marketed as herbal incenses, room deodorizers or air fresheners. Cannabimimetic compounds are classified into eight groups according to the following chemical structures: (i) naphthoyindole JWH-compounds (i.e. JWH-018, JWH-073, and JWH-398), (ii) naphthylmethylindoles (JWH-184), (iii) naphthoylpyroles (JWH-307), (iv) naphthylmethylindenes (JWH-176), (v) phenylacetylindoles (JWH-250), (vi) cyclohexylphenol CP-compounds (CP 47,497 and CP47,497-C8 analog), (vii) classical cannabinoids HU-compounds (HU-210) and (vii) benzoylindoles (AM694 and RCS-4). Almost all countries have scheduled one or more compounds or structural classes. Identifying which substances are currently on the market is a significant challenge for forensic and clinical laboratories, as well as developing analytical methods for new designer drugs that requires knowledge of the drug's metabolism. To circumvent legislation, manufacturers constantly market new compounds. Synthetic cannabinoids are almost exclusively excreted as metabolites in urine (Hutter, Broecker, Kneisel, Auwarter (2012); Grigoryev, A., Melnik, A., Savchuk, S., Simonov, A., Rozhanets, V. (2011); Chimalakonda (2012), the most common screening matrix in clinical, workplace, military and doping drug testing. Knowledge of urinary metabolites is required for developing effective urine testing methods.

Synthetic cannabinoids are not detected in standard laboratory cannabinoid screening tests, making it difficult to identify abusers. For personnel subject to drug monitoring, including military, police, fireman, pilots, truck, train and bus drivers, and athletes, designer drugs are an attractive alternative due to the need to undergo random or routine drug testing. Efforts have been focused on developing analytical methods for the quantification of synthetic cannabinoids and its metabolites. There are a variety of approaches available for identifying synthetic cannabinoid metabolites in urine. First, high throughput immunoassay screening requires knowledge of the metabolites and pure material to immunize animals for the production of antibodies. Immunoassays have been available for the primary drugs of abuse since the 1970's; however, rarely were new drugs introduced requiring the development of new assays. Over the last five years, dozens of new compounds have been introduced at an alarmingly rapid rate, with no end in sight. Development of a novel immunoassay is a time consuming process, and many question the financial wisdom of investment, especially when many compounds disappear rapidly from the market once scheduled. The Randox Biochip

Array Technology for synthetic cannabinoids was the first available assay for this new class of designer drugs. We tested 20,017 urine samples for synthetic cannabinoids with this new technology. Three different antibodies on one biochip targeted JWH-018, and the fourth, JWH-250 metabolites. In order to validate the sensitivity, specificity and efficiency of the assay, we developed and fully validated a qualitative liquid chromatography tandem mass spectrometry (LC-MS/MS) confirmation method that confirmed the identity of 9 synthetic cannabinoid parent compounds (JWH-018, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250, AM2201, MAM2201, RCS-4) and 20 metabolites, the most extensive assay available at the time (Wohlfarth, Scheidweiler, Chen, Liu, & Huestis**,** 2013). As the numbers of synthetic cannabinoids increased, we developed a quantitative LC-MS/MS assay for JWH-018, JWH-019, JWH-073, JWH-081, JWH-122, JWH-200, JWH-210, JWH-250, JWH-398, RCS-4, AM-2201, MAM-2201, UR-144, CP 47,497-C7, CP 47,497-C8 and their metabolites, and JWH-203, AM-694, RCS-8, XLR-11 and HU-210 parent compounds, a total of 53 synthetic cannabinoid analytes simultaneously in urine (unpublished data). Both methods were designed to facilitate addition of new compounds as they enter the market.

The best means to accomplish the identification of new human designer drug metabolites is to conduct controlled synthetic cannabinoid administration studies; however, the basic toxicology of these compounds is unknown, ruling out obtaining the necessary Investigational New Drug application (IND) from the Food and Drug Administration (FDA). With the lack of *in vivo* studies, *in vitro* human liver microsomes or human hepatocyte cultures with the analyte produce metabolites that can be identified with high-resolution accurate mass time of flight mass spectrometry. Human liver microsomes provide phase I metabolites only, and not necessarily with the prevalence found in human urine. The advantage of the human hepatocyte technique is that both phase I and phase II metabolites are produced and in proportion to those found in authentic urine.

Finally, it is apparent that a rapid, high-throughput assay is needed to identify analytes quickly as they appear on the market. TripleTOF® 4600/5600 high resolution accurate mass systems are capable of full MS range data collection and simultaneous MS/MS confirmation, providing an ideal platform for screening specified targets and also unregulated new analogues. Recent developments in LC multiplexing further improves throughput and makes LC-MS/MS effective for screening applications. Our goal is to develop the TripleTOF screening assay that enables positive screening results to be confirmed simultaneously with multiple screening criteria including MS/MS matching.

Methods

The Randox Biochip Array Technology, the first commercially available immunoassay for synthetic cannabinoids, was utilized to screen according to manufacturer's instructions more than 20,000 urine specimens collected worldwide. A Randox Evidence Biochip Array Analyzer processed approximately 1500 tests per hour. All presumptive positive urine specimens and an approximately equal number of urine specimens from each batch were analysed by LC-MS/MS to confirm the presence of synthetic cannabinoid analytes.

After the introduction of the Randox Biochip Array assay, other manufacturer's introduced synthetic cannabinoid immunoassays including National Medical Services (NMS), Neogen and Immunalysis. The NMS and Neogen assays were performed on the Freedom Evo 100 automated ELISA instrument, while the Immunalysis assay is a homogenous assay performed on the Olympus AU400e. Presumptive positive and negative specimens were confirmed by LC-MS/MS. Sample preparation included hydrolysis and protein precipitation. The method identified 9 synthetic cannabinoid parent compounds (JWH-018, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250, AM2201, MAM2201, RCS-4) and 20 metabolites (JWH-018 N-(5-hydroxypentyl), JWH-018 5-hydroxyindole, JWH-018 6-hydroxyindole, JWH-018 N-pentanoic acid and JWH-018 N-(5-hydroxypentyl) glucuronide; JWH-073 N-(4-hydroxybutyl), JWH-073 5-hydroxyindole, JWH-073 6-hydroxyindole and JWH-073 N-butanoic acid; JWH-081 N-(5-hydroxypentyl); JWH-122 N-(5-hydroxypentyl); JWH-200 5-hydroxyindole and JWH-200 6-hydroxyindole; JWH-210- N-(4-hydroxypentyl), JWH-210 N-(5-hydroxypentyl), JWH-210 5-hydroxyindole and JWH-210 N-pentanoic acid; JWH-250 N-(4-hydroxypentyl), JWH-250 N-(5-hydroxypentyl), JWH-250 5-hydroxyindole and JWH-250 N-pentanoic acid; AM2201 N-(4-hydroxypentyl) and AM2201 5-hydroxyindole; RCS-4 N-(5-hydroxypentyl) and RCS-4 N-pentanoic acid) of 9 parent compounds (JWH-018, JWH-073, JWH-081, JWH-122, JWH-200, JWH-210, JWH-250, AM2201, and RCS-4). These compounds were selected based on synthetic cannabinoids identified in worldwide seized drug reports, literature review, data from commercial laboratories and commercially-available standards at the time of method development. Special emphasis was placed on developing a method that enabled rapid inclusion of additional analytes as the standards became available. After enzymatic hydrolysis, urinary proteins were precipitated with acetonitrile. Chromatography utilized a 10 min gradient on a Kinetex XB-C18 column with 0.1% formic acid in water and acetonitrile. Scheduled multiple reaction monitoring ‘survey scans’ were followed by information-dependent acquisition enhanced product ion scan experiments on an ABSciex 5500 QTRAP mass spectrometer. Analytes were identified by software-assisted library searching against reference spectra.

For our simultaneous quantification of 53 synthetic cannabinoid analytes in urine, enzyme hydrolyzed urine was extracted with 1 mL Biotage SLE+ columns. Specimens were reconstituted in 150 µL mobile phase consisting of 50% A (0.01% formic acid in water) and 50% B (0.01% formic acid in 50:50 methanol: acetonitrile). 4 and 25 µL injections were performed to acquire data in positive and negative ionization modes, respectively. The LCMSMS instrument consisted of a Shimadzu UFLCxr system and an ABSciex 5500 Qtrap mass spectrometer with an electrospray source. Gradient chromatographic separation was achieved utilizing a Restek Ultra Biphenyl column with a 0.5 mL/min flow rate and an overall run time of 19.5 and 11.4 min for positive and negative mode methods, respectively. Quantification was conducted in MRM mode with CP 47,497 compounds and HU-210 ionized via negative polarity; all other analytes were acquired in positive mode.

As an example of our human hepatocyte, high-resolution accurate mass spectrometry approach to identifying metabolites, we determined the metabolic profile of XLR-11, the fluorinated UR-144 analog. 10µM XLR-11 was incubated with pooled human hepatocytes and sampled after 1 and 3h. Samples were clarified via centrifugation at 15,000g, 4ºC for 5min and diluted 1:4 with mobile phase before 10µL injection. Blank mobile phase, a neat 50µg/L XLR-11 standard and the 0h- sample also were analyzed as controls. Samples were analyzed by high-resolution mass spectrometry (TripleTOF 5600, AB SCIEX), with a time of flight scan followed by information-dependent acquisition triggered product ion scans with dynamic background subtraction and mass defect filters. Scans were thoroughly data-mined with different data processing algorithms (Metabolite Pilot 1.5).

Results

1428 urine specimens screened positive with the Randox biochip synthetic cannabinoid assay. 1073 negative samples were selected from the 20,017 samples for confirmation. Although the assay was highly sensitive 97.9%, there were many false positive screening results, 1149, producing a specificity of only 48.1% and an efficiency of 53.8%. The other synthetic cannabinoid screening tests achieved better performance. The NMS ELISA with a 5 ng/mL cutoff had 241 true positives, 2158 true negatives, 50 false positives and 43 false negative tests for 84.9% sensitivity, 97.7% specificity and 93.6% efficiency. The Neogen ELISA also with a 5 ng/mL cutoff had 74.5% sensitivity, 98.8% specificity, and 95.2% efficiency, as compared to the LC-MS/MS qualitative confirmation. The homogeneous Immunalysis synthetic cannabinoid assay had 87.7% sensitivity, 97.3% specificity and 96.2% efficiency with a 5 ng/mL cutoff. The assay performed better with this cutoff than the 10 ng/mL cutoff recommended by the manufacturer. All assays cross-reacted with additional synthetic cannabinoid compounds, but are not sensitive for the detection of newer generations of designer cannabinoids.

The LC-MS/MS quantitative assay for 53 synthetic cannabinoid analytes achieved low limits of quantification of 0.1-1.0 µg/L, and upper limits of linearity of 50-100 µg/L ($r2 > 0.994$). Validation parameters were evaluated at three concentrations spanning the linear dynamic ranges. Inter-day recovery (bias) and imprecision (N=20) were 88.3-112.2% and 4.3-13.5% relative standard deviation, respectively. Extraction efficiencies and matrix effects (N=10) were 44-110% and -73 to 52%, respectively.

In response to scheduling efforts, new analogs required constant surveillance and inclusion of newly emerging substances into analytical assays. Synthetic cannabinoids are extensively metabolized. The most comprehensive prior report identified metabolites of seven synthetic cannabinoids: JWH-018, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250 and RCS-4 [7]. The primary metabolism route in humans is hydroxylation of the alkyl side chain and the indole ring, as well as hydroxylation of the adamantyl structure or aromatic naphthyl or phenyl systems, and side chain carboxylation. For halogenated compounds like AM2201 and AM694 enzymatic dehalogenation was observed [4, 14]. We utilized human hepatocyte incubation and high-resolution accurate mass spectrometry to determine the metabolism of XLR-11. XLR-11 underwent phase I and II metabolism producing more than 25 metabolites resulting from hydroxylation, carboxylation, hemiketal and hemiacetal formation, internal dehydration and further glucuronidation of some oxidative metabolites. No sulfate or glutathione conjugation was observed. XLR-11 also was defluorinated forming UR-144 metabolites. Based on MS peak areas, major metabolites were 2'-carboxy-XLR-11, UR-144 pentanoic acid, 5-hydroxy-UR-144, hydroxy-XLR-11 glucuronides and 2'-carboxy-UR-144 pentanoic acid. Minor metabolites were combinations of the biotransformations mentioned above, often glucuronidated. These are the first data defining major urinary targets of XLR-11 metabolism that will document XLR-11 intake in forensic and clinical investigations.

Conclusions

Designer synthetic cannabinoids pose a major challenge for toxicology laboratories attempting to provide sensitive and specific monitoring in driving under the influence of drugs cases, other accident investigations, drug treatment and workplace drug testing. We evaluated the performance of commercially available immunoassays, necessitating development of a sensitive and specific confirmation assay. We further extended the capabilities of the assay by doubling the number of synthetic cannabinoid analytes included and making the assay quantitative. We also developed a human hepatocyte incubation technique to produce phase I and phase II metabolites of XLR-11, and other new synthetic cannabinoids that were identified by high-resolution accurate mass TOF mass spectrometry. And finally, we are developing a high-resolution mass spectrometry TOF assay for screening urine for the presence of a large number of synthetic cannabinoids markers.

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Evaluation of the on-site Draeger DrugTest 5000 in occasional and chronic frequent smokers following controlled cannabis smoking

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Abstract

Background
Cannabis is the most commonly reported illicit drug in drugged driving cases. Achieving accurate oral fluid (OF) cannabinoid on-site results is challenging and essential.

Aims
Device performance and OF cannabinoid detection windows 30h post-smoking were evaluated in occasional (<2x/week) and frequent (≥4x/week) cannabis smokers.

Methods
10 occasional and 14 frequent smokers (18-45 years) provided written informed consent for this Institutional Review Board-approved study, and smoked *ad libitum* one 6.8% THC cannabis cigarette. OF was collected with the DrugTest 5000 test cassette and Oral-Eze® collector (Quest Diagnostics) before and frequently up to 30h post-dose. Test cassettes were analyzed immediately and compared to two-dimensional gas chromatography mass spectrometry (2D-GCMS) cannabinoid results from simultaneously collected Oral-Eze OF.

Results
404 paired OF were collected; 9 samples (2.2%) were invalid, yielding 395 OF pairs for comparison. Sensitivity, specificity and efficiency were 75.3, 94.1, and 81.8% and 66.4, 98.9, and 73.9% with 2 ng/mL THC proposed SAMHSA and 1 ng/mL DRUID confirmation cutoffs, respectively. Sensitivity was 6-11% higher in chronic frequent as compared to occasional cannabis smokers due to longer detection windows and higher true positive rates. Median (range) last detection times with the DrugTest 5000 were 12h (4-24) and 21h (1->30) for occasional and frequent smokers, respectively (p=0.12, >30 assigned as 30h). Three frequent smokers were still positive at 30h, but had up to 5 negative specimens prior to 30h.

Discussion and conclusions
Sensitivity of the DrugTest 5000 5 ng/mL cutoff was lower for occasional as compared to chronic frequent smokers over the extended 30h monitoring window with the 2 and 1 ng/mL confirmation cutoffs; however, these authentic data after controlled smoking document the best performance to date for on-site cannabinoid tests. Sensitivity within 6 and 8h time frames, representing recent smoking, were 85.6 and 84.7%; and 84.0 and 82.5% at the proposed SAMHSA and DRUID confirmation cutoffs, respectively.

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Introduction
Cannabis sativa (marijuana) has been smoked for its medicinal and psychoactive properties for thousands of years and is the most widely consumed illicit drug in the world (Vega et al.,

2002). Worldwide, 119-224 million people (2.6-5.0%) aged 15-64 consumed cannabis at least once in 2010 (World Drug Report 2012). In 2011 in the United States, 18.1 million Americans 12 years and older (7.0%) reported past-month use and 4.3 million Americans (1.6%) reported past-year cannabis dependence or abuse (Results from the 2011 National Survey on Drug Use and Health: Summary of National Findings. 2012). In addition, 872,000 Americans received treatment for cannabis dependence or abuse, second only to alcohol. Cannabis is also common in driving under the influence of drugs (DUID) cases. Δ^9-tetrahydrocannabinol (THC) was the most prevalent illicit drug detected in injured drivers (9.8%) in Victoria, Australia (Drummer, Kourtis, Beyer, Tayler, Boorman, Gerostamoulos, 2012). Similarly, in the first US Roadside Survey in 2007, cannabinoids were identified in oral fluid and/or blood in 8.6% of nighttime drivers (Lacey et al., 2009). Nearly two-thirds of U.S. trauma center admissions were due to motor vehicle accidents, with almost 60% positive for drugs or alcohol (Walsh et al., 2004). Acute cannabis intoxication produces dose-related impairment in cognitive and psychomotor functioning, as well as risk-taking behavior (McDonald, Schleifer, Richards, de Wit H., 2003); Ramaekers et al., 2006). Reaction time (RT), perception, short-term memory and attention, motor skills, tracking, and skilled activities are altered (Ramaekers, Berghaus, van Laar, Drummer, 2004; Riedel and Davies, 2005). Driving within one hour of smoking cannabis increased crash risk (odds ratio (OR) 1.84 (Asbridge, Poulin, Donato, 2005) and 2.61 (Mann et al., 2007), even after adjustment for demographic characteristics. In France, drivers in fatal crashes with detectable THC in blood had a 3.17 OR for crash responsibility (Laumon, Gadegbeku, Martin, Biecheler; SAM Group, 2005). Driving under the influence of cannabis or synthetic cannabinoids prior to or during driving increases the risk of death or injury and is an important public safety concern.

Oral fluid drug testing in workplace, pain management, drug treatment and DUID programs is increasing due to advantages in drug monitoring including easy, less invasive specimen collection, lack of the need for a same-sex collector, and less opportunity for adulteration. Elucidating cannabinoid oral fluid pharmacokinetics after controlled smoked cannabis is essential for determining drug detection windows, markers of recent smoking, and minimizing potential for passive environmental smoke contamination. The ideal drug detection window varies depending upon the goals and design of drug testing programs. For workplace, pain management, and drug treatment research follow-up visits, a long drug detection window is ideal, as testing opportunities are widely separated. However, drug testing during accident investigations or “for cause” testing is focused on recent use and potential impairment. Controlled cannabis administration and sequestration of participants on closed research units to eliminate self-administered drugs provide data for rigorously determining windows of drug detection in oral fluid and improving result interpretation. Oral fluid testing offers non-invasive sample collection for on-site drug testing; however, until recently (Desrosiers et al., 2012), test performance for THC detection had unacceptable diagnostic sensitivity. On-site tests must accurately identify cannabis exposure since this drug accounts for the highest prevalence in workplace drug testing and DUID programs. The DrugTest 5000 on-site device provided high diagnostic sensitivity and specificity for detection of cannabinoid exposure.

We conducted a controlled smoked cannabis administration study are to characterize and contrast the disposition of THC and its metabolites in blood, plasma, urine, oral fluid, and breath in occasional and chronic frequent cannabis smokers. In addition, we evaluated the sensitivity, specificity, accuracy, and predictive values of the Draeger DrugTest 5000® for identifying cannabinoids in oral fluid as compared to cannabinoid results when oral fluid was collected with the Oral-Eze collector (Quest Diagnostics) before and frequently up to 30 hours after smoking a 6.8% THC cigarette.

Methods

Study Design

This clinical study, approved by the National Institute on Drug Abuse Institutional Review Board, recruited chronic frequent cannabis and occasional smokers. The study consisted of a three day, two-night stay on a closed clinical research unit. Baseline measures and biological samples were collected before drug administration. Participants smoked ad-libitum (10 min maximum) one 6.8±0.2% (54 mg) THC, 0.25±0.08 cannabidiol (CBD), and 0.21±0.02% cannabinol (CBN) cannabis cigarette the morning of Day 2 and provided oral fluid samples up to 30 hours after smoking.

Participants

Occasional and chronic frequent cannabis smokers (age 18-45 years) were recruited from the community by advertising and word-of-mouth. Occasional smokers self-reported an average smoking frequency <2 times per week in the past 3 months. Chronic frequent smokers self-reported an average smoking frequency ≥4 times per week in the past 3 months and had a positive urine cannabinoid test. Additional inclusion criteria included peripheral veins suitable for venipuncture, blood pressure ≤140 mm Hg systolic and 90 mm Hg diastolic, heart rate ≤90 bpm, and an electrocardiogram and 3-minute rhythm strip without clinically significant abnormalities. Exclusion criteria included history of any clinically significant illness, based on medical history, physical examination, and clinical laboratory tests, history of a clinically significant adverse event associated with cannabis intoxication, donation of more than 450 mL blood in previous 30 days, pregnancy or nursing, or interest or participation in drug abuse treatment within the past 60 days. Pregnancy tests were administered at screening and on the morning of drug administration to women with reproductive potential. The National Institute on Drug Abuse Institutional Review Board approved the study. All participants provided written informed consent and were compensated for their study participation.

Sample collection and analysis

The OralEze® device was utilized for oral fluid collection at admission (16 to 19 h before drug administration), 1 hour before, and 0.5, 1, 2, 3, 4, 5, 6, 8, 10.5, 13.5, 21, 24, 26, 28, and 30 hours after smoked cannabis. Oral intake, including smoking, was prohibited 10 min before oral fluid collection. The collection device consists of an absorptive cotton pad, a volume adequacy indicator that turns blue upon collection of 1 mL oral fluid, and a plastic tube containing 2 mL stabilizing buffer, yielding a 1:3 oral fluid dilution. Following manufacturer recommendations, analytes were eluted from the pad at room temperature for at least 12 hours. Oral fluid analysis generally occurred within 24 h of collection. THC, 11-OH-THC, THCCOOH, CBN, and CBD were quantified by two-dimensional gas chromatography mass spectrometry (2D-GCMS) according to a previously published method (Milman, Barnes, Lowe, Huestis, 2005) with minor modifications: calibrators and quality controls were prepared with 0.25 mL blank oral fluid and 0.5 mL Oral-Eze® buffer, identical with the 1:3 dilution of authentic samples. Intra-assay imprecision was 1.0%-4.7%, inter-assay imprecision was <7.6%, and bias was 88.2%-110.1%. The following pad recoveries were observed: THC, 42.5-48.8%; 11-OH-THC, 43.5-54.5%; THCCOOH, 68.1-86.2%; CBN, 35.6-58.7%; and CBD, 33.5-47.7%.

DrugTest 5000 on-site oral fluid monitoring device

The DrugTest 5000 consists of an analyzer, a test cassette, and buffer cartridge to determine if cocaine, opiates, benzodiazepines, cannabinoids, amphetamines, or methamphetamine are present in oral fluid above specified cutoffs. After the buffer cartridge and test cassette are inserted into the instrument, the analysis is automated and the cartridge is pushed onto the tip of the test cassette for the lateral flow immunoassay. Test cassettes were calibrated during production with fortified native oral fluid and the threshold for a positive result encoded on the test cassette. Objective results are displayed on a screen as "Positive", "Negative," or "Invalid". An invalid result occurs if the instrument detects improper lateral flow. THC results are acquired in 8.5 min, while other drugs are obtained in 5 min. The DrugTest 5000 test cassette was equipped with a polymeric non-compressible pad for oral fluid collection. Oral fluid was collected by swiping the test cassette on the tongue and side of the cheeks. Test cassettes were analyzed immediately and compared to 2D-GCMS cannabinoid results from simultaneously collected Oral-Eze oral fluid.

Data analysis

Qualitative oral fluid DrugTest 5000 cannabinoid results were evaluated against a pre-programmed 5 μg/L THC cutoff. True positive (TP, DrugTest 5000 and GC-MS positive), true negative (TN, DrugTest 5000 and GC-MS negative), false positive (FP, positive DrugTest 5000, but less than GC-MS specified cutoff) and false negative (FN, negative DrugTest 5000, but positive GC-MS at specified cutoff) results were calculated at 5 μg/L THC DrugTest 5000 screening cutoff and 1 (Driving Under the Influence of Drugs, Alcohol and Medicines, DRUID), and 2 (Substance Abuse and Mental Health Services Administration, SAMHSA) GC-MS THC confirmation cutoffs. Diagnostic sensitivity (100×(TP/[TP+FN])), diagnostic specificity (100×(TN/[TN+FP])), and efficiency (100×([TP+TN]/[TP+TN+FP+FN])) were calculated at one screening and multiple confirmation cutoffs. Rates of detection and windows of detection were evaluated with the DrugTest 5000 screen and different confirmation analytes and cutoffs.

Results

Fourteen chronic, frequent and 10 occasional cannabis smokers spent the night before smoking on the clinical unit to ensure that participants were not intoxicated at the time of smoking. Chronic, frequent users reported smoking a median (range) of 28 cannabis joints per week (21-147), while occasional smokers reported 0.75 cannabis joints per week (0.06-2.5). Four hundred and four paired oral fluid specimens were collected; 9 samples (2.2%) were invalid, yielding 395 oral fluid pairs for comparison. Sensitivity, specificity and efficiency were 66.4, 98.9, and 73.9% with the 1 ng/mL DRUID, and 75.3, 94.1, and 81.8% with the 2 ng/mL THC proposed SAMHSA confirmation cutoffs, respectively. Sensitivity was 6-11% higher in chronic frequent as compared to occasional cannabis smokers due to longer detection windows and higher true positive rates. Median (range) last detection times with the DrugTest 5000 were 12 hours (4-24) and 21 hours (1->30) for occasional and frequent smokers, respectively (p=0.12, >30 assigned as 30 hours). Three frequent smokers' oral fluid specimens were still positive at 30 hours, but had up to 5 negative oral fluid specimens prior to 30 hours.

Discussion and conclusions

The DrugTest 5000 was easy to operate and provided reliable results and operation. The instrument was designed to be operated by non-medical personnel in the field under diverse weather and lighting conditions. The oral fluid collection device has a volume indicator to tell the operator when sufficient oral fluid is collected. The device can only be inserted into the instrument in one way, and the reading of the reaction line is performed by the instrument, a major advantage over many other on-site tests that require the operator to read the presence or absence of a line to indicate a qualitative positive or negative test result. This is especially difficult under poor on-the-road lighting conditions.

Analysis of cannabinoids has been the major challenge to on-site oral fluid tests due primarily to poor sensitivity, although many other devices also had frequent false positive screening results. We previously reported sensitivity, specificity and efficiency of the Draeger DrugTest 5000 at a 5 ng/mL screening cutoff and 1 ng/mL DRUID (87.7%, 77.8% and 86.4%), and 2 ng/mL SAMHSA (90.7%, 75.0%, and 87.9%) 2D-GCMS analysis of oral fluid collected with the Quantisal oral fluid device in chronic frequent cannabis smokers. For the first time, we present performance data for the DrugTest 5000 5 ng/mL cutoff with the same confirmation cutoffs in oral fluid collected with the Oral-Eze collection device. Sensitivity of the DrugTest 5000 5 ng/mL cutoff was lower for occasional as compared to chronic frequent smokers over the extended 30 hours monitoring window with the 1 and 2 ng/mL confirmation cutoffs; however, these authentic data after controlled smoked cannabis document the best performance to date for on-site cannabinoid tests. Sensitivity within 6 and 8 hours time frames, highly relevant for DUID testing and representing recent cannabis smoking, were 85.6 and 84.7% and 84.0 and 82.5% at the proposed SAMHSA and DRUID confirmation cutoffs, respectively. These data document that a sensitive and specific on-site screening test for cannabinoids in oral fluid is available for use in DUID, workplace and drug treatment programs. The device is easy to use and produces reliable screening results. These data should advance the possibility of oral fluid testing for roadside testing, providing a deterrent for drugged driving, and a means of improving public health and safety.

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Increased criminal activity among people suspected of driving under the influence of alcohol or drugs. A register-based population-level study.

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Abstract

Background
Driving under the influence (DUI) has been connected in increased criminal activity in previous research. More detailed information is needed from the backgrounds and following activities of DUI offenders.

Aims
Aim of the study was to examine differences in the range of criminal activity between people who had history of driving under influence of alcohol (DUIA), drugs (DUID) and reference population with no history of DUI.

Methods
Data on arrested DUI suspects and age-sex matched reference population was linked with criminal records. Between 1992 and 2005 there were 69,990 DUIA suspects, 5,667 DUID suspects and 74,359 references. Data on crime consisted of 645,967 criminal convictions of which 6 % was committed by non-DUI reference population.

Results
At least one offence was found in 94%, 96% and 17% of DUIA, DUID and references respectively. Average number of convictions per person was 5.2, 43.3 and 0.5 registered cases respectively. Most common offences were traffic violations and crimes against property. Almost half of DUID suspects had history of violent crime.

Discussion and conclusions
DUI offenders have increased criminality in comparison to general population. Especially involvement of drugs correlates with high criminal activity. General explanation behind DUI and other crime may include substance abuse problems and low respect of law. Early substance abuse interventions should be considered as a part of crime prevention.

Introduction

Harms related to substance abuse are estimated to be very costly to the societies around the world. One of the most apparent forms of alcohol and drug abuse is driving under the influence (DUI). DUI is directly a traffic safety problem as drunk-drivers are more likely to cause accidents and fatal crashes (Drummer et al. 2004, Zador, Krawchuk & Voas 2000).

People arrested of DUI are also more likely to be risky drinkers or alcohol dependents (Portman et al. 2009, Brinkmann et al. 2002) and having more other substance abuse problems

LLL. They also suffer higher mortality (Impinen et al. 2010, Karjalainen et al. 2009b) and morbidity (Karlsson et al. 2003) than general population. It is suggested that roadside testing of DUI is the most cost-efficient way to reduce alcohol harms (Anderson, Chisholm & Fuhr 2009).

Societal costs of alcohol also include crime. Drunk-driving is most typically crime by itself under so called per se law. It is also linked with history of previous crime (Hubicka, Laurell & Bergman 2008, LaBrie et al. 2007, Webster et al. 2008) and subsequent criminal activity including DUI relapse (Nochajski, Stasiewicz 2006, Siskind, Schonfeld & Sheehan 2000).

Previous studies have found positive connection between drunk-driving offences to auto theft, drug trafficking, drug possession, stolen goods, assault and weapons possession (Webster et al. 2008).The link between multiple offences and crime was found stronger than for people with only single arrest (Webster et al. 2008). Also for males a link between DUI and being victim of domestic violence has been studied even this could not be found statistically significant (Muelleman, Burgess 1998).

Material and methods

The main data on DUI were results of blood tests and evidential breath tests which have been performed on people suspected of driving under the influence of alcohol (DUIA) or drugs (DUID). Blood tests have been analysed and all data have been stored at Finnish National Institute for Health and Welfare. These data include the observed blood alcohol content (BAC) and possible pharmaceuticals found in blood. These data do not include information on possible convictions of the drivers and thus the subjects should be called suspected DUI offenders.

An age-sex matched data on reference population was drawn from general population register for DUI data. The inclusion criterion for references was that they should have no record of DUI suspicion by the year their counterpart became a DUI suspect. Thus they are also matched by their entry to the data.

Both cases and their references were matched with their criminal convictions between 1970 and 2005. The crimes were classified in 8 main groups which are presented in table 1.

Suspects of DUI were grouped according to substances found in their blood. If person had history with DUI suspicion including any controlled substance, they were grouped as DUID suspects. If there were no history with other substances than alcohol they became DUIA group. Drugs were furthermore grouped to opioids, amphetamines, cannabis and benzodiazepines.

Results

Between 1992 and 2005 the data on drunken drivers included 69,990 drunk drivers with record of driving under the influence of alcohol only, 5,667 drivers with record of driving under the influence of drugs, and 74,359 age sex matched reference cases with no known record of drunk driving. Mean ages in the groups were 36 years, 31 years and 35 years respectively. In all groups there were 13% of women.

In DUIA group 94% of people had record of conviction while in DUID group 96% had a conviction and among references 17% had some kind of criminal conviction. Similarly 71%, 85% and 13% had conviction not related to traffic violations.

Table 1 presents the numbers of convictions, convictions per person and distribution of convictions according to the type of crime and DUI status. While most crime is committed by DUIA group it is evident that criminal activity accumulates to DUID group who have eight times more convictions per person than DUIA suspects and ninety times more convictions compared to the reference population.

All DUI suspects had a peak of convictions within the year the DUI took place. This is probably because DUI arrest might bring out several other charges such as reckless driving, resisting law enforcement, possession of illegal drugs or possession of stolen goods. While examining one year and three year periods before and after the suspected DUI, both DUIA and DUID suspects had fewer convictions in the time period preceding the DUI suspicion than the time period following. While this can partly be due to data restrictions such as data entry point being suspected first DUI (i.e. there should be no DUI before that) also other type of crime increased, especially within DUIA group while within DUID and references the figures were more stable.

Crimes were furthermore examined according to the drugs found from blood. With DUID cases there were 1,219 people classified as opioid users, 1,675 amphetamine users, 623 cannabis users and 1,830 benzodiazepine users. Highest crime per person was found from opioid and amphetamine groups, 68 and 59 crimes per person respectively. Cannabis and benzodiazepine users had significantly lower figures, 32 and 21 crimes per person which were still much higher than from the DUIA group.

While examining one-year and three-year periods before and after DUI suspicions there was increasing number of convictions in DUIA and DUID groups while the number was steady among the references. The increase was found in opioid and amphetamine users in both 1-year and three-year periods while there was no change in cannabis and benzodiazepine groups in one-year period and some decrease in three-year period.

Table 1 – Total convictions, convictions per person and distribution of convictions by crime type and DUI history

	Convictions			Per person			Percentage within group		
	DUIA	DUID	Ref	DUIA	DUID	Ref	DUIA	DUID	Ref
Number of people	69,990	5,667	74,359						
A Crimes against property	86,202	96,549	13,773	1,23	17,04	0,19	24	39	38
B Crimes against life and health	21,381	8,422	4,974	0,31	1,49	0,07	6	3	14
C Sexual crimes	515	90	182	0,01	0,02	0,00	0	0	0
D Crimes against public authority and	6,158	4,834	1,256	0,09	0,85	0,02	2	2	3

public peace									
E Selected traffic offences	204,049	87,019	8,548	2,92	15,36	0,11	56	35	23
F Other offences against the Penal Code	15,797	25,208	4,108	0,23	4,45	0,06	4	10	11
G Alcohol offences	2,088	540	602	0,03	0,10	0,01	1	0	2
H Offences against other Acts and Decrees	27,730	22,588	3,115	0,40	3,99	0,04	8	9	9
Total	364,059	245,293	36,615	5,20	43,28	0,49	100	100	100

Strengths and weaknesses of the study

All data used in this study were register-based and no other kind of data collection was performed. This allows rather cheap and easy access to large data which can be linked together using unique personal identification codes. However using different register data has its limitations. Due to privacy regulations only 50% sample of DUI suspects was used in original data. Data on DUIA, DUID and crimes were not available on exactly the same time period and could be combined reliably only between 1992 and 2005. While the first observed DUI arrests from DUI register were used to determine first-time offenders, there sometimes were DUI convictions found in the crime register before this. This might be caused by imperfect personal ID codes.

The data and their magnitude are however unique. There are records of 150,000 individuals with over half million crime convictions nationwide during a 14-year time period involved in the study. Proportion of missing data is very small and data is considered reliable. Despite some flaws the data can be considered accurate.

Ethical considerations

All data was cleared of direct personal identification codes and researchers had no possibility to identify people involved in registers.

Conclusions

Among suspected DUI offenders there is increased criminal activity which is more than DUI convictions only. Most crimes are committed by those who drink and drive but there clearly exists a hard core of criminal activity formed by drugged drivers. High number of crime in both DUIA and DUID groups are signals of possible marginalization which is furthermore supported by increasing number of crime after the DUI suspicions. Connections between socio-economic position and crime DUI and crime in general have been well established (Aaltonen 2013, Impinen et al. 2011, Karjalainen, Blencowe & Lillsunde 2012). It can be speculated that the problems might be escalating among some DUI offenders as there is continued crime and health problems (Impinen et al. 2010, Karjalainen et al. 2009a) and high rates of DUI recidivism (Impinen et al. 2009) which also suggest a severe alcohol and drug dependency among this population. Criminal and traffic policies alone cannot cope with the entire problem and wider approach with social and healthcare interventions are needed for DUI offenders.

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Knowledge and behaviours of drunk driving offenders in Guangzhou, China

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Abstract

Background
Alcohol is a major contributor to road crashes in China (Li, Xie, Nie, & Zhang, 2012; Cochrane, & Chen, 2003). Two levels of offence are defined in legislation: the lower level is driving under the influence (DUI, also translated as "drink driving") and the higher level is driving while intoxicated (DWI, also translated as "drunk driving", where the driver has BAC≥0.08mg/100ml). This study focuses on a 2011 legislative amendment that made drunk driving (DWI) a criminal offence. However, it is not known whether drivers are aware of the law, and whether this knowledge, their exposure to enforcement and the existence of alcohol use disorders relate to their drink driving behaviour. This study explored these relationships in a sample of convicted drunk drivers.

Method
A survey collected information about offenders' knowledge and practices related to drunk-driving in Guangzhou. The Alcohol Use Disorders Identification Test (AUDIT) (Babor, & Grant, 1989; Chen, & Cheng, 2005) assessed hazardous drinking levels. In total, 101 drunk driving offenders were recruited while in detention.

Results
Males represented 90% of the sample; the average age was 33.6 years (SD=8.7; range 17-59 years). The average age at which offenders reported starting to drink alcohol was 19.5 years (SD=4.1; range 8-30 years). Driver's licences had been held for a median of 7 years. Knowledge about legal limits for DUI and DWI offences was surprisingly low, at 27.7% and 40.6% respectively. On average, offenders had experienced 1.5 police alcohol breath tests in the previous year (SD=1.3; range 1-10). AUDIT scores indicated that a substantial proportion of the offenders had high levels of alcohol use disorders. Higher AUDIT scores were found among the least experienced drivers, those with lack of knowledge about the legal limits, and recidivist drunk drivers.

Discussion and conclusions
Limited awareness of legal alcohol limits might contribute to offending; high levels of alcohol consumption by many offenders suggest that hazardous drinking levels may also contribute. Novice drivers are a concern and their higher AUDIT scores merit some follow-up. Overall, this study provides important information to assist in refining community education and prevention efforts to align with China's new regulations.

Introduction

Alcohol is a major contributor to road crashes in China (Li, 2012; Cochrane, 2003). According to statistics from the Traffic Management Bureau under the Ministry of Public Security (MPS, 2012), there were 4,912 traffic crashes relevant to drinking and driving, 1,957 deaths and 5,221 serious injuries in 2011. One study conducted in two Chinese cities, supported by the Global Road Safety Partnership (GRSP), revealed that an average of 34.1% of road crashes (Nanning: 25.7%; Liuzhou:48%) were alcohol related, the mean BAC level of the drivers in the accidents was 156.7 mg/dl, and the highest BAC was 310mg/dl in 2007 (Yuan, Li and Zhang; 2013). China introduced a legislative amendment to make drunk-driving a criminal offence on 1st May, 2011. This amendment represents a major change in the treatment of offenders. Motorists convicted of drunk driving/DWI (i.e., $\geq$0.08mg/100ml) now have a criminal offence recorded against them. According to the official statistics from Guangzhou Public Security Bureau (Wang, 2012), from 1st May 2011 to 30th April 2012, traffic police officers identified 4,750 drink driving cases, among them 877 cases of drunk driving. According to the local traffic police detachment report, there were 37 traffic accidents related to drink driving in 2011 in Guangzhou. These accidents led to 21 deaths in Guangzhou, which accounted for 11.73% of the national total, and 42 injured in Guangzhou, which accounted for 7.32% of the national total. The present study explored whether convicted drunk drivers were aware of the law and whether this knowledge, their exposure to enforcement and the existence of alcohol use disorders related to their drink driving behaviours.

Method

Self-report 15 minute surveys about drink driving knowledge and practices were completed by 101 drunk driving offenders in Guangzhou between May and October, 2012. Two staff from the local custody were trained as research assistants and conducted the survey with drunk driving offenders while in detention.

Design and procedure
Information included: demographics; knowledge about drinking and driving; drinking and driving behaviours; and perception of deterrents to drinking and driving. The Alcohol Use Disorders Identification Test (AUDIT) (Babor, 1989) assessed hazardous drinking levels using the World Health Organization (WHO) cut-off scores. Because there is no “standard unit of alcohol consumption” concept in China, we asked participants how much alcohol they consumed and then coded the amount as a standard unit to calculate the AUDIT score. The study was approved by the QUT Research Ethics Committee (approval number 1100001462).

Results

Socio-demographic characteristics
The sample was predominantly male (90.1%) with an average age of 33.6 years (SD=8.7; range 17-59 years) with 20.8% between 17 and 25 years old; 63.4% were married and one-third had tertiary qualifications (33%).

The majority (70%) of offenders had a monthly income between 1,300-10,000RMB; 9.9% earned less than 1,300RMB and 17.8% more than 10,000RMB. Just over half (53.5%) had a permanent job while 16.7% were unemployed (including students and retired people). The number of years licensed varied from 0.5 to 27 years with a median of 7 years; 7.9% offenders had no licence. Professional drivers (e.g. taxi, bus and truck drivers) made up 20% of the sample.

Knowledge about drinking and driving
The majority (84.2%) knew that drunk driving had become a criminal offence in May 2011, but knowledge about legal limits for DUI (27.7%) and DWI (40.6%) was surprisingly low. Almost all offenders had no knowledge of how to keep their BAC under the legal limit. Correct answers for the amount of alcoholic beverages that could be consumed to remain under the legal limit were given by only 2% of participants for spirits, 6.9% for wine and 1% for beer.

Drinking and driving behaviours
The age when alcohol was first consumed ranged from 8-30 years: mean 19.5 years; SD = 4.1. Less than half reported that they had been drinking over the legal limit and subsequently: driven a car (41.6%), ridden a motorbike (47.5%), driven another vehicle (13.9%) or ridden a bicycle (34.7%). About 37% of the offenders reported that they had driven a car, motorbike or other motor vehicle on a public road while over the legal BAC at least once in the last 12 months. In the same period 35.7% reported being a passenger of a drunk driver. The majority (77.7%) reported that at least occasionally they tried to keep track of the amount of alcohol they had consumed if they were driving.

Deterrence
In addition to the offence for which they were currently being punished, 20.8% had been caught for another drink/drunk driving offence in the last three years but only 10.9% had previously received a penalty for it. In the last month, 72.3% had been stopped at least once by police conducting breath alcohol testing and 18.8% had been tested twice. On average, offenders experienced 1.5 police alcohol breath tests in the previous year (SD=1.3; range 1-10). The majority (77.2%) admitted that their alcohol reading was above the legal limit at the last testing and 21.8% of them had been previously jailed for drunk driving.

Alcohol Use (AUDIT)
The mean AUDIT score of these convicted drink driving offenders is 11.1, representing a medium level of alcohol problems. Table 1 gives the AUDIT score distribution.

Table 1. Percentage of AUDIT Score for drink driving offenders

Alcohol problem severity	AUDIT score	Numbers	Percentage
Low	0-7.9	35	35%
Medium	8-15.9	45	45%
High Level	16-19.9	7	7%
Need further diagnostic evaluation for alcohol dependence.	20 or more	13	13%

There was no significant difference between the level of AUDIT score in females (11.6) and in males (11.1) and a moderate negative correlation between age and AUDIT score, r = -0.3, n = 101, p < 0.01.

Offenders were divided into four licence groups: novice drivers (licensed for less than two years); licensed 2-5 years; licensed 6-10years; and experienced (licensed 11 years or more).

Table 2. Years of driver's license and AUDIT score

Group	n	AUDIT Mean	Mean difference from Group 1 (1-G)	SD	*P* (1-G)

1. Novice driver (<2 years)	13	16.4	0	7.6	
2. Licensed 2-5 years	26	11.3	5.1	6.0	<0.05
3. Licensed 6-10 years	30	9.9	6.5	4.0	<0.01
4. Licensed 11years or more	26	8.7	7.7	4.3	<0.01
Total	95	11.1		5.9	

One-way ANOVAs showed that the AUDIT score of the novice driver group was significantly higher than the other three groups (F (3, 91) = 6.5, p < 0.01), with no difference between the other groups (Table 2).

There was a moderate negative correlation between the age the respondent started drinking and their AUDIT score, r = -0.4, n = 100, p < 0.01. AUDIT scores did not vary significantly by level of education, with all means lying between 10.2 and 12.9.

Those who knew the legal limit level for drunk driving (M = 9.8, SD = 5.16) had a significantly lower mean AUDIT score than those who did not (M = 12.2, SD = 6.26; n = 96, p = 0.05). Recidivist drivers had a higher AUDIT score (M = 15.1, SD = 6.48) than first time convicted offenders (M = 9.9, SD = 4.9; n = 95, p = 0.001). There were no significant differences in AUDIT scores by income category or drinking frequency.

Discussion and conclusions

Most of the drunk driving offenders were male and had a median 7 years driving experience, which was very similar to the findings in the Guangxi province research project (Yuan, 2013).

Income level did not influence frequency of drinking for these offenders. In the Chinese alcohol beverage market, the prices of bottles of beer, wine and spirits vary from around less than 10RMB to hundreds or thousands of RMB. This spread of prices allows for ready substitution to maintain alcohol consumption without spending more money.

A positive finding is that 84.2% of the sample knew that drunk driving became a criminal offence in May 2011. This would be expected given their recent convictions. However, given their awareness of the new law, their knowledge about legal limits for DUI and DWI offences was surprisingly low. If we compared the rate of awareness of the lowest national BAC limit (DUI) with the result of a baseline survey on drink driving in Nanning and Liuzhou in 2007, awareness was 4.8% prior to the legislative changes in 2011 (Yuan, 2013). In the present study, Guangzhou's drunk drivers had a higher rate of awareness (27.7%). However, this difference at least partially reflects the nature of our sample (drunk driving offenders): after they were apprehended for drunk driving, their exposure to legal proceedings might have given them the opportunity to learn the two levels of limits for drinking and driving. Even if they had known the correct limits, the results show that drunk drivers had little knowledge of how to keep their BAC under the legal limit. It is clear that both general drivers and drunk drivers need further education on this important information.

From the offenders' reports of exposure to enforcement, it appears that breath alcohol testing has been implemented well in Guangzhou. On average, offenders had experienced 1.5 police breath alcohol tests in the previous year. In comparison, the GRSP baseline survey on drink driving of general drivers in Nanning and Liuzhou found that 78 percent had never been stopped by the traffic police for a BAC check during 2005-2006 (Yuan, 2013). While the higher level of exposure to BAC testing reported in this study is promising, it may indicate only that habitual drunk drivers were more exposed to drink driving enforcement than general drivers, as might be expected. It is worth noting, however, that it has been suggested that enforcement, along with stricter penalties introduced in 2011, has contributed to a reported 41.4% decrease in drink driving and 44.5% in drunk driving in the first year of operation (Hong, 2012).

The finding that the more recently licensed drunk driving offenders had higher AUDIT scores is arguably consistent with the rapid increases in alcohol consumption and related problems that have been observed in China (Hao, 2007; Zhang, 2004), although the dramatic difference between this group and all others merits further investigation.

Recidivist drink driving offenders had higher AUDIT scores than first time drink driving offenders. These offenders can have a heavily entrenched behaviour, and their drink driving behaviours can prove difficult to change (Freeman, Schonfeld et al. 2007). Interventions such as re-education, rehabilitation, or installation of interlocks need to be considered.

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The dynamic effects of Random Breath Testing on traffic accidents in Australian states

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Abstract

Background: Alcohol-involved traffic accidents are costly in terms of death, injuries and damage. Random Breath Testing (RBT) has been considered as an effective mean to reduce alcohol-related crashes. Although a number of studies on RBT have been conducted demonstrating its effectiveness, there are few of studies that assess the effect of RBT on traffic accident mortality using long-term time series analysis, especially, in different age groups.

Aims: This study aims to apply a sophisticated technique to examine the dynamic effects of RBT on age-specific traffic accidents in four Australian states, namely, New South Wales (NSW), Victoria (VIC), Queensland (QLD) and Western Australia (WA).

Methods: Long-term time series of age-specific traffic accident deaths in four Australian states were used to analyse the impact of RBT implementation. The methodology comprises five main stages to produce appropriate Autoregressive Integrated Moving Average (ARIMA) models with intervention dummies.

Results: The results of intervention analysis indicate that RBT has substantially reduced traffic accident mortality in all four states since it was introduced, particularly among 17-20 and 21-30 year olds. NSW received the biggest total net effect from RBT implementation on traffic deaths with estimated reductions of 1132 and 1267 for 17-20 and in 21-29 years old drivers respectively from 1983 to 2010. Traffic accident deaths of young drivers between 17 and 20 years old in VIC were reduced by an estimated 1099 from 1977 to 2010 following the implementation of RBT. In contrast, RBT produced no significant reduction in traffic mortality among 30-39 year olds.

Discussion and conclusions: Controlling for the declining trend in traffic accidents, the implementation of RBT has generated a huge effect, preventing an estimated 5309 traffic accident deaths in Australian four states over 27 years. This provides further evidence that RBT is an effective policy for reducing traffic accidents, particularly among young people.

Introduction

Traffic accidents represent a key cause of injury and death globally, and were the single largest cause of injury-related burden in the most recent global burden of disease (Lopez 2012). Alcohol is a key contributor to this burden, with around 40% of traffic deaths in Australia attributed to alcohol (Collins and Lapsley 2008). Random Breath Testing (RBT) is a widely used drink-driving countermeasure in many countries and is particularly common in Australia (Rowland *et al.* 2012). A meta-analysis on the effects of drink driving checkpoints was conducted by Erke *et al.* (2009), the authors found that drink-driving check points (include RBT) significantly reduced the number of vehicle crashes by a minimum of 17%. RBT can effectively deter social drinkers and problem drinkers, and the introduction of RBT in Britain could save at least 400 lives a years (Dunbar *et al.* 1987).

Random breath testing system aims to deter potential drink-drivers, by increasing their chance of being apprehended (or even just their perception of the likelihood that they'll be detected). This is implemented via the assessment of drivers' breath alcohol concentration (BAC, the limit may differ in difference countries based on traffic regulations) of drivers at randomly located check points (Homel 1993). Police are authorised to pull over motorists for breath testing and the test needs to be highly visible, unpredictable, supported with publicity and perceived to be ubiquitous (Rowland *et al.* 2012). RBT was first introduced in Victoria, Australia in July, 1976, but has now spread around the world (Solomon *et al.* 2011).

In Australia, RBT was implemented at the state level. Following Victoria in 1976, RBT was implemented in NSW in December 1982; WA in October 1988 and QLD in December 1988 (Henstridge *et al.* 1997). Early evaluations found that the introduction of RBT in NSW reduced all fatal accidents by 22% and alcohol-related accidents by 36 % (Homel 1993). Although a number of studies on RBT have been conducted, there are few studies that assess the effect of RBT on traffic accidents using long-term time series analysis (autoregressive moving average model, know as Box Jenkins (1970) approach), particularly focussing on the impacts in different age groups. The key Australian analysis (Henstridge *et al.* 1997) used time-series methods based on daily data to estimate the impact of RBT in NSW, WA and Queensland, estimating a total reduction of 2,583 fatal accidents over a ten year period (1982-1992). We extend this work by examining a longer time-series (albeit based on annual data) and by using age-specific mortality data to ascertain how the effects of RBT were distributed across age groups. Specific research questions addressed by the study were:

1. What are the long-term effects of the introduction of RBT on traffic accident mortality in four Australian states?
2. How do these effects vary across age groups?

Methods

Prior to 1989, data on age-specific traffic fatalities were compiled from historical statistical publications (e.g. NSW Department of Motor Transport (1960) and Commonwealth Bureau of Census and Statistics (1958)). For the years from 1989 onwards, data were available in the Australian Road Deaths Database (2013). Due to vagaries in reporting standards between states and over time, pre-1989 data were not available for consistently defined age groups. In particular, estimates for fatalities among 17-20 year olds in Western Australia (between 1950 and 1959), New South Wales (between 1950 and 1952) and Victoria (between 1950 and 1954) and Queensland (1950-1985) were not available and had to be derived by estimating proportionally from other age groups. For example, the Queensland data generally provided deaths for 15-19 year olds and for 20-24 year olds. Using years where more detailed breakdowns were available, we estimated the proportion of 15-19 year old deaths likely to involve 17-19 year olds and the proportion of 20-24 year old deaths involving 20 year olds to produce an estimate for 17-20 year old deaths, which allowed for consistent analyses with the remaining states.

The autoregressive moving average model (ARIMA) with an intervention dummy was employed to analysis the long-term effect of RBT on the traffic accidents in this study (1970). This approach includes moving average (MA) or autoregressive (AR) terms in the statistical model and enables modelling of any systematic impact of measurement errors and factors not included in the model on the independent variable (Ramstedt 2008). The prior condition for the time series analysis is that all the series are required to be stationary, with time trends removed to avoid the risk of obtaining a spurious estimation (George 1994). In most cases, a differencing of the time series is sufficient to eliminate non-stationarily (Norström 2001). An ARIMA (1,1,1) model with dummy variables can be written as follow:

$$\Delta Y_t = \alpha + \beta \Delta Y_{t-1} + \sum_i \gamma_i D_{i,t} + \delta \Delta E_{t-1}$$

Where Δ is the differencing operator, Y_t represents the dependent variable at time *t* (age-specific traffic accident death in four states), α is constant (which marks average annual changes due to other causes), β is the coefficient value of AR(1) term, δ is the coefficient value of the MA(1) term (ΔE_{t-1}), $D_{i,t}$ is the one-off event dummy variables and $\gamma_i$is the estimates of the effect of the events or interventions. The one-off event dummy variables have been widely applied in many studies to analysis effect of seasonality, major changes in policy and financial crises (Mann *et al.* 2000; Norström 2000; Jiang and Liu 2011). Prior to the event the dummy variable is coded as 0. At the onset of the event the intervention dummy is coded as 1 and it remains at 1 for the duration of the presence of the event.

In this study, the introduction of RBT in NSW was on December 1982; VIC (July 1976); QLD (December 1988) and WA (October 1988). Thus, based on the length of the time series in this study, the intervention period of RBT on these four states can be defined as 1983-2010 in NSW; 1977-2010 in VIC; 1989-2010 in QLD and 1989-2010 in WA. Time series data from 1951 to 2010 were used, ensuring that sufficient data pre- and post- the intervention were available. The models estimate the change in mortality due to the intervention based on the assumption that traffic accident deaths would otherwise have followed the trend from the pre-RBT period. This allows us to estimate the total effect of RBT on traffic accident deaths in the four states.

Results

Results of the analyses are presented in Table 1 for all four states. The estimated effects are presented for the age groups 17-20, 21-29 and 30-39 years. The results suggest that RBT has prevented large numbers of accident deaths in NSW, particularly for young adults 1132 and 1267 lives saved among 17-20 and 21-29 year olds respectively. The total net effects of RBT on traffic accident deaths in NSW were 41%, 31% and 8% for 17-20, 21-29 and 30-39 year olds from 1983 to 2010. The model specification for each ARIMA model is reported in the tables and model fit was evaluated by Box-Ljung portmanteau test for uncorrelated residuals in each model (at 10 lag). The effect of RBT in Victoria is similar to NSW, with 37% and 17% reductions in traffic accident deaths for 17-20 and 21-29 year olds respectively. The prevention effect of RBT on traffic accident deaths for the 30-39 year olds was 2% between 1977 and 2010.

Table 1 Effect of RBT on traffic accident deaths in NSW, Vic, Qld and WA

Period	17-20 years			21-29 years			30-39 years		
	Actual accidents	Estimated accidents	Effect	Actual accidents	Estimated accidents	Effect	Actual accidents	Estimated accidents	Effect
NSW		*(0,1,1)*			*(0,1,0)*			*(1,1,2)*	
1983	194	230	-36	229	309	-80	102	140	-38
.	.	.	.	.	.	.	.	.	.
1997	73	137	-64	122	187	-65	95	100	-5
.	.	.	.	.	.	.	.	.	.
2010	53	50	3	73	73	0	58	64	-6
Total net effects =			-1132			-1267			-198
Total net effects in percentage =			41%			31%			8%
VIC		*(0,1,0)*			*(1,1,0)*			*(0,1,1)*	
1977	170	178	-8	218	220	-2	109	112	-3
.	.	.	.	.	.	.	.	.	.
1997	61	106	-45	82	128	-46	48	65	-17
.	.	.	.	.	.	.	.	.	.
2010	40	59	-19	66	75	-9	34	47	-13
Total net effects =			-1099			-696			-51
Total net effects in percentage =			37%			17%			2%
QLD		*(0,1,1)*			*(0,1,1)*			*(1,1,2)*	
1989	82	78	-4	96	121	-25	67	70	-3
.	.	.	.	.	.	.	.	.	.
1997	67	62	-5	81	104	-23	47	60	-13
.	.	.	.	.	.	.	.	.	.

2010	33	35	-2	47	69	-22	38	53	-15
Total net effects =			-74			-479			-6
Total net effects in percentage =			6%			29%			0.5%
WA		*(1,1,0)*			*(1,1,0)*			*(1,1,2)*	
1989	52	53	-1	70	63	7	29	30	-1
.	.	.	.	.	.	.	.	.	.
1997	34	41	-7	37	59	-22	34	32	2
.	.	.	.	.	.	.	.	.	.
2010	19	17	2	48	51	-3	32	37	-5
Total net effects =			-84			-188			-35
Total net effects in percentage =			12%			17%			5%

Note: ARIMA model specification is represented as (a, b, c). Box-Ljung portmanteau tests (Q-statistic) suggest that there was no systematic variation in the residuals of models.

The estimated effects in QLD and WA suggest that the implementation of RBT was effective for all age groups with 559 lives saved in QLD and 307 in WA between 1989 and 2010. The effects of RBT on traffic accident deaths in these states were strongest for 21-29 year olds, with smaller and inconsistent effects found in the younger and older age groups. The variation in effects seen over time in these two states is in part due to the smaller numbers being modelled, but may also relate to variations in both enforcement and public campaigns raising awareness of RBT, both of which have been shown to be important in maintaining RBT effectiveness (Henstridge *et al.* 1997).

Conclusion

This study has presented a time series analysis of the effect of RBT on traffic accident death in Australian four states. The results suggest that the implementation of RBT has produced a sufficient prevention effect on traffic accident mortality in Australia. In NSW, VIC, QLD and WA, the impacts of RBT on traffic accident death were overall 27%, 20%, 12% and 14% respectively among 17-39 year olds. There was clear evidence from across the four states that RBT had a greater impact on younger drivers, with the 30-39 year old age group having only modest mortality reductions due to RBT.

Due to data limitations, this study has not specifically estimated the impact of the amount of actual RBT enforcement on traffic mortality, a key factor in some earlier analyses (REF to H & H 1997 again). Despite this, the study produced similar aggregate results to these previous analyses, while providing the first clear evidence of the age distribution of the effects of RBT in Australia. It is possible that the effects presented here overestimate the impact of RBT by not considering a range of other polices (e.g. compulsory seatbelt laws) that may have reduced road deaths. In contrast, the effects in Queensland and Western Australia may be underestimated due to the impacts of the lowering of the drinking age in those states during the 1970s. Further research will expand this work to address the potential confounding effects of these policy changes. In spite of these limitations, our study adds to the robust international literature showing that, controlling for the declining trend in traffic accidents, the implementation of RBT greatly reduce fatal road accidents in Australia, preventing an estimated 5309 traffic accident deaths in Australian four states.

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Measuring the impairment of different doses of alcohol on car driving related skills: a calibration study

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Abstract

Background
Medication and illicit drugs can have detrimental side effects which impair driving performance. In the field of drugs and driving, there is no consensus on which psychometric tests are best suited for initial screening of a drug's impairment potential.

Aim
The aim of this calibration study is to indicate which performance tests are useful to determine drug-induced impairment and to compare their psychometric quality.

Methods
Twenty four healthy young volunteers (12 females and 12 males; mean age 22.7 years) participated in a double-blind, 4-way crossover, study. Treatments were placebo and three different doses of alcohol leading to Blood Alcohol Concentration levels of 0.2, 0.5, 0.8 mg/ml. Effects on performance were measured using several tests often used in the different research fields measuring driving impairment.

Results
Results showed significant dose effects of alcohol in all tests, except at the digit span test. Compared with placebo, performance in the Divided Attention Test was significantly impaired after all alcohol doses; performance in the Psychomotor Vigilance Test and the Balance Test was impaired after a moderate and a high dose, and performance in the Attention Network Test and the Digit Symbol Substitution was significantly worse compared with placebo only after a high dose of alcohol. Effects on tracking and concept shifting were inconsistent.

Discussion and conclusions
According to this study, three tests seem to be more preferable over others to evaluate a drug's impairment potential. The Divided Attention Test, the Psychomotor Vigilance Test, and the Postural Balance Test were sufficiently sensitive to detect effects of alcohol while BAC levels are 0.5 mg/ml, which is the legal limit for driving in most countries. Further research should investigate sensitivity of these tests compared with other benchmarks and their validity in predicting actual driving ability as assessed in real life scenarios.

Introduction

Many people use drugs other than alcohol (i.e. medicinal and illicit drugs) which can impair performance (e.g. Vingilis, & Macdonald, 2000; Walsh et al., 2004). Because of the large number of people involved and the severity of the consequences, one of the most important risks of medicinal and illicit drug is that of impaired driving performance and traffic accidents (e.g. O'Hanlon, 1984). Therefore, standardized scientific evaluation of drug induced performance impairments information is needed providing more meaningful precautions for users and prescribers regarding the impacts of drugs on driving (Kay & Logan, 2011). In addition, there is an increasing demand from regulatory authorities to provide more information on the risks of drug-induced impairment of driving. This concerns not only newly developed medicinal drugs as part of the dossier for registration, but also marketed and illicit drugs to determine thresholds for drug concentrations in blood associated with driving impairment (e.g. Verstraete et al., 2011).

Guidelines

Methodological guidelines for experimental studies assessing the effects of drugs on driving (e.g. Vermeeren et al., 1994; ICADTS 1999; Kay, & Logan, 2011) indicated that relatively simple tests may be used as a first step in screening a drug's impairment potential, and that more sophisticated procedures (e.g. driving simulators, on-the-road testing) should be included in a later stage. Among the more sophisticated tests, the standardized highway driving test (O'Hanlon, 1984) used in the Netherlands, is generally regarded as the golden standard (Verster & Roth, 2011). However, no consensus has been reached on the specific tests to be used for initial screening. Such tests have to be widely available, easy to implement and be relatively cost effective. Nonetheless, in order to provide relevant information they should be valid with respect to measuring driving performance, have reasonable test-retest reliability, and be sufficiently sensitivity to detect drug induced impairment (Walsh et al., 2008; Kay & Logan, 2011). To ensure comparability of results from various research settings, procedures should be standardized and results calibrated by benchmark drugs and doses.

Alcohol as benchmark

The most well known and widely used benchmark drug for driving impairment is alcohol (e.g. Louwerens et al., 1987, Gonzalez-Wilhelm, 2007). The increase of risk for traffic accidents is well established for various legal limits of Blood Alcohol Concentration (BAC) levels. Performance tests for measuring drug effects on driving related skills should be dose-dependently sensitive to drug induced impairment and ideally be able to detect the effects of alcohol at BACs of 0.5 mg/ml and higher. A BAC of 0.5 mg/ml is the legal limit for driving a car in most European countries. In addition, some countries have lower limits for younger and less experienced drivers (e.g. BAC 0.2 mg/ml in The Netherlands). Drug effects comparable to those of alcohol at BACs between 0.5 and 0.8 mg/ml are generally classified as moderately severe, whereas drug effects comparable to BACs over 0.8 mg/ml are classified as severe.

Measures of driving related skills

There is general agreement that tests of visual attention, psychomotor functions and executive control are highly relevant for assessing drug effects on driving (e.g. Krüger et al., 1990; Ranney, 1994). Review of the literature shows a number of tests are preferably used to assess driving impairment, but they differ depending on area of research or practice.

Aim

The aim of this study was to indicate which performance tests are useful to determine drug-induced impairment and to compare their psychometric quality. In this study, we intended to select tests for measuring driving performance used in various fields of research and to measure the essential domains of driving. Furthermore, we intended to assess their sensitivity to the effects of increasing doses of alcohol (resulting in blood alcohol concentrations between 0.0 and 0.8 mg/ml) in a group of healthy young volunteers.

Subjects

Twenty-five healthy male and female volunteers (ages 18-30 years) were recruited through poster advertisements at Maastricht University. Initial screening was based on a medical history questionnaire examined by a medical supervisor. One subject dropped out after the familiarization session for reasons unrelated to treatment. A total of 24 subjects (12 men, 12 women) completed the study. Their mean ± SD age was 22.7 ± 2.3 years and their mean ± SD BMI was 22.5 ± 2.0 kg m^{-2}. The study was conducted in accordance with the code of ethics on human experimentation established by the declaration of Helsinki (1964) and amended in Seoul (2008).

Design and alcohol administration

The study was conducted according to a double-blind, placebo controlled, fourway cross-over design. Treatments were alcohol doses to reach BAC levels of 0.0 mg/ml (i.e. placebo), 0.2 mg/ml, 0.5 mg/ml, and 0.8 mg/ml. Subjects participated in two treatment days during which two doses of alcohol were administered. The first dose was to achieve a low BAC (i.e. 0.0 or 0.2 mg/ml) and the second dose was to achieve a high BAC (i.e. 0.5 or 0.8 mg/ml). The order of test days was balanced over subjects. The placebo dose consisted of a glass of orange juice with a small amount (3 ml) of alcohol floating on the surface of the beverage, shown to function in previous studies as subjects indicated that the beverage contained alcohol (e.g Fillmore, & Vogel-Sprott, 1998). In the other conditions, subjects were treated with several alcohol (97%) challenges mixed with orange juice. The alcohol dosing regimen was developed to achieve blood alcohol concentrations (BACs) of 0.0 mg/ml, 0.2 mg/ml, 0.5 mg/ml, and 0.8 mg/ml..

Procedure

Subjects were individually trained to perform the behavioral tests. The behavioral tests were undertaken twice at two separate days. During participation in the study, alcohol intake was not allowed from 24h prior to each dosing until discharge. On treatment days, caffeine intake and smoking was not allowed until discharge. Subjects agreed not to use any drugs of abuse or oral medication (except oral contraceptives and aspirin) during the study.

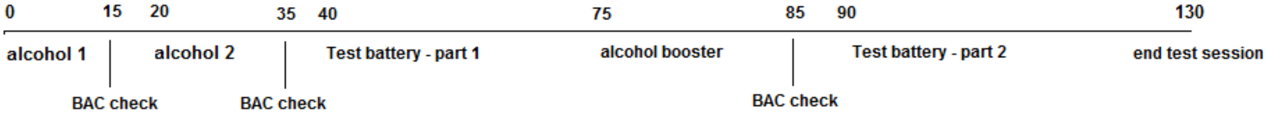


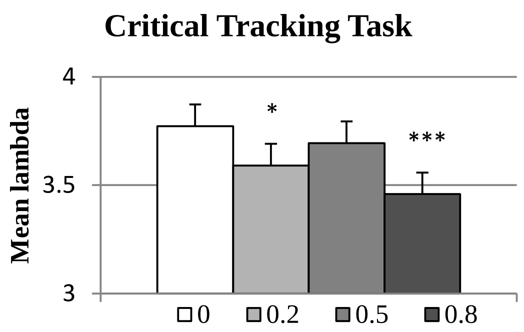
Fig. 1: Procedure.

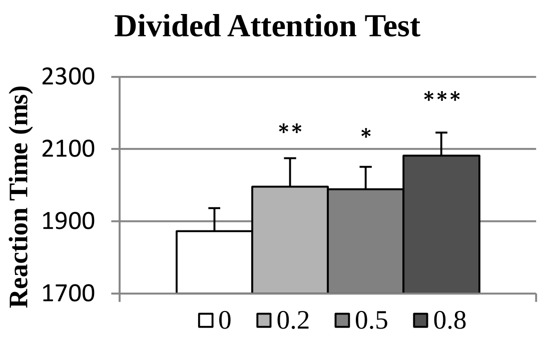
Assessment

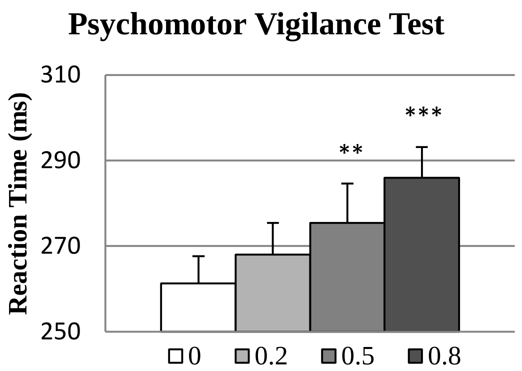
Eight different objective measures were used to measure the alcohol induced impairment: a Critical Tracking Test (CTT), a Divided Attention Test (DAT), the Psychomotor Vigilance Test (PVT), the Digit Symbol Substitution Test (DSST), the Attention Network Test (ANT), the Concept Shifting Test (CST), the Digit Span Test (DST), and a Postural Balance Test (PBT). Furthermore, subjective measures were used (i.e. Visual Analogue Scales).

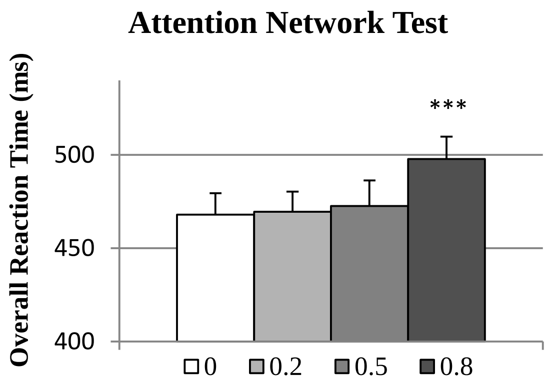
Statistical analysis
Sample size calculation was based on detecting a minimally relevant difference with an effect size of 0.25 between placebo and the 0.5 mg/ml BAC condition. Given a test-retest reliability of tracking error of at least $r = 0.75$ (Ramaekers et al., 2011*)*, a group of 24 subjects should permit detection of a mean change in tracking error, with a power of at least 90% and an α of .05. The global model used in the repeated-measures analysis of variance of all cognitive and psychomotor parameters included treatment. In case of a significant overall effect, a subsequent analysis for comparing separate alcohol doses was conducted using three simple contrasts. To determine the magnitude of the effects of alcohol, Dunlap et al.'s (1996) effect size (i.e. $t_c[2(1-r)/n]^{1/2}$) statistic was calculated on reaction time and accuracy data. Effect sizes are not reported in this working paper. All statistical analyses were done by using the Statistical Package for the Social Sciences for Windows (version 19; SPSS Inc, Chicago, III).

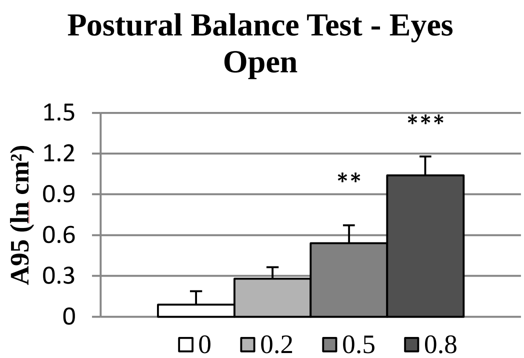
Results

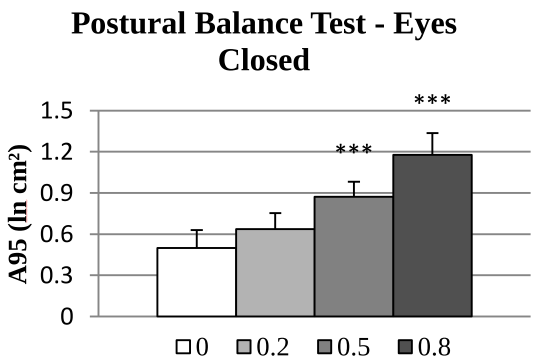












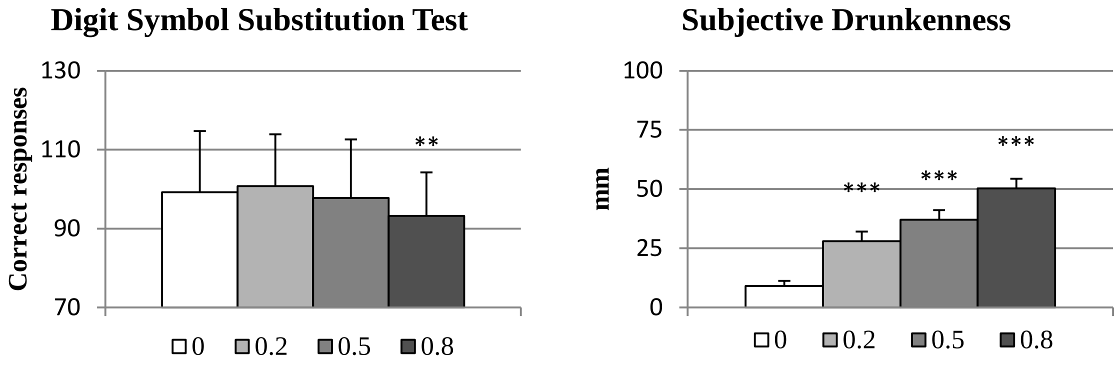


Fig. 2: Results at several objective and subjective tests. All asterisks indicate significant differences compared to placebo. * = p < .05, ** = p < .01, = p < .001.***

Discussion

The aim of the present study was to indicate which performance tests are useful to determine drug induced impairment and to compare their sensitivity to different doses of alcohol. Tests related to driving skills from various research fields were selected. The most preferable tests to include for measuring drug induced impairment are the Psychomotor Vigilance Test to measure automative behavior (e.g. vigilance), a Divided Attention Test to measure more controlled behavior (e.g. divided attention), and a Postural Balance Test to measure psychomotor coordination. These tests are more preferable, as impairment was found after alcohol doses reaching a BAC level of 0.5 mg/ml or higher. These tests can be used as reference value to compare the impairing potential of a drug with the legal limit of driving under the influence of alcohol. The Attention Network Test and the Digit Symbol Substitution Test are less preferable, as impairing effect was found only after doses which reached a BAC level of 0.8 mg/ml.

Future research

Future research should examine psychometric tests for all psychometric qualities, i.e. validity, reliability, and comparability. These tests should be calibrated by different benchmarks to ensure their usefulness in initial screening. Furthermore, predictive validity of these tests should be measured, to ensure their validity to measuring driving impairment after medical or drugs ingestion.

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Lowering of the Alcohol Limits for Drivers in Ireland and the Analytical Impact

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Abstract

Context
The Road Traffic Act (RTA) 2010 [1] was enacted on 28th October 2011 in the Republic of Ireland. This introduced two lower alcohol limits while retaining three higher penalty limits resulting in a total of five graded penalty levels. The two lower limits of 20mg/100ml and 50mg/100ml in blood are related to driver status; that is specified driver or non-specified driver respectively. Specified drivers are defined as learners, newly qualified drivers and professional drivers. This offered challenges in the areas of calibration, quality assurance and measurement of uncertainty for the Medical Bureau of Road Safety (Bureau) which is the national statutory body responsible for chemical testing of intoxicants in driving in Ireland.

Objectives
In preparation for the introduction of the new alcohol limits the Bureau aimed to introduce a method of calibration that would enable accurate analysis and reporting at the lower levels for both evidential breath testing instruments and blood and urine specimens.

Key Outcomes
Calibration and testing schemes including measurement of uncertainty budgets for evidential breath testing, breath screening and alcohol in blood or urine programmes were devised, validated and implemented to ensure accurate analysis and reporting of alcohol in specimens at all levels. Accredited status for the three testing schemes was maintained under the ISO 17025 standard.

Discussion and conclusions
Before the introduction of the RTA 2010 a % deduction had been subtracted from all analytical results prior to issue. Calculated uncertainty budgets demonstrated that this approach was not appropriate for all limits included in the RTA 2010. A % deduction remains in place over part of the measurement range while appropriate absolute deductions are made at lower limits.

Introduction

The responsibility for chemical testing of intoxicants in driving in Ireland rests with the Medical Bureau of Road Safety. The functions of the Bureau are laid down in the Road Traffic Acts 1968-2010 and their regulations. They include the receipt and analysis of specimens of blood and urine for intoxicants, the issue of certificates of analysis, the provision of equipment for the taking of specimens of blood and urine, the approval, supply and testing of apparatus for indicating the presence of alcohol in breath and the approval, supply and testing of apparatus for determining the concentration of alcohol in breath.
The Road Traffic Acts include defined alcohol limits for blood, urine and breath and since 1995 graded penalties were applied depending on alcohol concentration found in the specimen provided. In October 2011, the 2010 RTA[1] was enacted and this included an additional two lower limits for each specimen type. Table 1 shows the original limits along with the current limits.

Table 1 Alcohol limits set out in the Irish Road Traffic Acts.

	Blood mg/100ml	Urine mg/100ml	Breath µg/100ml
Added in Oct 2011	20	27	9
Added in Oct 2011	50	67	22
Pre Oct 2011	80	107	35
Pre Oct 2011	100	135	44
Pre Oct 2011	150	200	66

Blood and Urine Alcohol

The addition of the lower limits required a review of the laboratory's testing, calibration and reporting protocols for alcohol analysis in blood and urine specimens.

Procedure for Analysis of Alcohol in Blood and Urine
Analysis of blood and urine specimens for ethanol was carried out using headspace gas chromatography (HS-GCFID) systems. Propan-1-ol was used as an internal standard and used to dilute the sample at a 1:10 ratio. The laboratory used packed columns for alcohol analysis, 5% Carbowax 20M on 60/80 Carbopack B and 0.2% Carbowax 1500 on 80/100 Carbopack C. Using the two types of column with different separation characteristics enables identification of ethanol based on retention times and ensures other possible interfering volatiles will be detected. Each specimen was analysed once on two different systems which included the different column types, different HS-GCFID systems, different diluters and different scientists. Initial analysis was carried out using single point calibration at 80mg/100ml level and a further duplicate analysis was carried out using a three point calibration using 80,107 and 200mg/100ml standards when the initial results fell within defined critical ranges. The critical ranges are defined as an analytical range just above the legal alcohol limit, where a result will be issued that could lead to prosecution and the result issued would determine the penalty imposed. Table 2 details the critical ranges used in the laboratory.

Table 2 Critical Ranges for Alcohol in Blood and Urine pre 2010 RTA Limits

Blood limit mg/100ml	Critical Range		Urine Limit mg/100ml	Critical Range
80	87-100		107	115-128
100	108-121		135	145-158
150	161-174		200	214-227

In light of the lowering of the limit, new critical ranges were identified. Table 3 outlines the additional critical ranges adopted.

Table 3 Critical Ranges for Alcohol in Blood and Urine post 2010 RTA Limits

Blood limit mg/100ml	Critical Range		Urine Limit mg/100ml	Critical Range

20	25-38		27	32-45
50	55-68		67	73-86

A review of the calibration standards was carried out. Table 4 outlines the different standard curves investigated. Both three point and four point curves were examined.

Table 4 Standard Values for Multipoint Calibration

20mg/100ml	20mg/100ml	50mg/100ml	50mg/100ml
80mg/100ml	80mg/100ml	100mg/100ml	100mg/100ml
	107mg/100ml		150mg/100ml
200mg/100ml	200mg/100ml	200mg/100ml	200mg/100ml

R^2 values were used to determine the closeness of the calibration curve to unity. We found no significant difference between the three point curves and the four point curves. We found no significant difference between curves produced using ERM standards or in house Bureau standards. All curves examined had R^2 values of 0.9999 and intercept values close to 0.

Controls in the range 0 to 600mg/100ml prepared in-house and/or purchased were analysed using the different calibration curves as in Table 4 above and single point calibrations using either 20, 50 or 80mg/100ml standards were also examined. All results obtained, using the different calibrations were within the laboratories operating specification as outlined and all calibrations were fit for purpose. At this stage it was decided that the original protocol for analysis would be retained with different standard levels for calibration; for single point calibration a 50mg/100ml standard was selected and for multipoint it was decided that a three point curve using 20, 80 and 200mg/100ml would be used. Check standards are included across the measuring range throughout the analytical runs.

Reporting Alcohol in Blood and Urine and Application of Measurement of Uncertainty

The reported result was calculated by averaging the analytical results, truncating the result and applying a subtraction of 6% to determine the reported result in mg/100ml. The 6% subtraction was based on an historical maximum precision allowance of 2% multiplied by 3. However the laboratory typically attains precision of under 0.5% for relative standard deviations (RSD) and the new measurement of uncertainty was calculated using the specification laid out by the laboratory.

Table 5. MBRS Alcohol in Blood and Urine Linearity Specification for Single Point Analysis

Nominal Concentration mg/100ml	Maximum Permissible Error of the certified value	Repeatability Std. Dev mg
20	± 2mg/100ml	0.5
50	± 2mg/100ml	0.5
80	± 2mg/100ml	0.4

107	± 2% (2.14mg/100ml	0.535
200	± 2% (4.0mg/100ml)	1.0

The significant contributors to uncertainty of this method were identified as the maximum permissible error (MPE), the maximum precision (standard deviation) and the uncertainty of the calibrator. The uncertainty of the ERM calibrators is typically 0.6mg/100ml (k=2) which is equivalent to a standard deviation of 0.3mg/100ml.

Using the formula:

$$Uc=\sqrt{(MPE/\sqrt{3})^2 + (\text{std dev})^2 + (\text{uncertainty of calibrator})^2}$$

Where Uc is the combined uncertainty and the MPE was assumed to have a rectangular distribution, the uncertainty of the measurement was calculated across the range of 20 to 200 mg/100ml. An expanded uncertainty using a coverage factor of 3 was calculated for each level.
The expanded uncertainties were plotted against the standard values. The equation of the line was then used to calculate the uncertainty for each analytical value. The relative expanded uncertainty was shown to be greater at the lower levels.
A similar approach was used for calculating the uncertainty using the multipoint analysis.
It was shown to be appropriate to continue deducting 6% from the mean of the rounded down analytical value for values above 50mg/100ml and to deduct 4mg/100ml from values equal to and below 50mg/100ml.

Alcohol in Blood and Urine and Accreditation

The Medical Bureau of Road Safety maintains accreditation to ISO17025 standard[8] for alcohol in blood and urine analysis. The changes to calibration and reporting procedures were notified to the Irish National Accreditation Board (INAB) prior to their implementation, and on their review no extension to scope was required as the range of alcohol measurement was within the scope of the current accreditation which remains at 10mg/100ml to 600mg/100ml.

Evidential Breath Testing

Procedure for calibration and testing of instruments
Evidential breath testing was introduced to Ireland in 1999 and the lion intoxilyzer6000IRL instruments were chosen following an EU procurement process and installed in Garda Síochána (Police) Stations nationwide. The protocol was that the calibration was the responsibility of the manufacturer and it was carried out in their laboratory using wet bath standards. Post installation the instruments were tested on a six monthly basis on site using wet bath standards at 35, 44, 66 and 200µg/100ml levels. These tests were included as part of the full performance testing protocol. Certified dry gas ethanol standards at 35µg/100ml level were used for time of test validation during an evidential breath test.
With the introduction of the lower breath alcohol limits the performance of the breath test instruments was reviewed. While the lion intoxilyzer6000IRL was accurate at the lower levels it was not possible to adapt them to include mouth alcohol detection at the lower breath alcohol limits. As the instruments were also over 10 years old it was decided that new

instruments would be purchased. Following an EU procurement procedure the Evidenzer IRL was selected. These instruments included the required safeguards at the lower breath alcohol levels.
The manufacturer,(Nanopuls AB) is responsible for the calibration of the instrument. The EvidenzerIRL is wet bath calibrated. The calibration is verified using either wet bath or dry gas standards. The calibration and verification results must comply with the OIML R126: 1998 [2] recommendation as follows.
The MPE is 2.0µg/100ml for levels below 40µg/100ml and 5% of the reference value of mass concentration for levels between 40µg/100ml and 200µg/100ml.
Post installation the instrument is tested on a six monthly basis on site using wet bath standards at 9, 22, 35, 190µg/100ml levels. During the provision of an evidential breath test, each set of 2 breath~~s~~ specimens provided by the arrested person is now bracketed with dry gas standards, one at a level of 9µg/100ml and the other at a level of 22µg/100ml.

EBT Reporting and application of uncertainty

The Bureau had calculated the uncertainty budget for breath testing using the lion intoxilyzer 6000IRL based on test specifications and found it to be 17.5% with a coverage factor of 3. The evidential breath testing procedure requires a driver to provide two breath specimens. The lower of the two results is reduced by 17.5% and the resultant figure is reported as the breath alcohol concentration. This approach to reporting was retained when the new limits were introduced, however the measurement of uncertainty budget was reviewed to ensure that an appropriate deduction was being subtracted at all levels.
The calculation was carried out across the measuring range using a different approach than previously used with breath variability, instrumental components and traceability of dry and wet standards as the major contributors.[3,4,5,6]

Table 6. MBRS Evidential Breath Testing Linearity Specification.

Nominal Concentration µg/100ml ± 3%	Maximum Permissible Error of the certified value	Repeatability Std. Dev
0	0 to +2 µg/100ml	
9.0	±2 µg/100ml	0.7µg /100ml.
22.0	±2 µg/100ml	0.7µg /100ml.
35.0	± 5%	0.6µg /100ml.
190.0	± 5%	3.2µg /100ml.

It was confirmed that 17.5% is an appropriate deduction for all concentrations above 22µg/100ml, however for alcohol concentrations of 22µg/100ml and below a deduction of 5µg/100ml was required. The performance tests should comply with OIML 2012[7] specifications as shown in Table 6.

EBT and Accreditation

The Medical Bureau of Road Safety maintains accreditation to ISO17025 standard[8] for on-site testing of the evidential breath instruments. The changes to the EBT test method required an extension of scope of accreditation application as the test item had changed from one instrument type to another. The Bureau submitted and was granted extension to scope after a full review of the new test method.

Conclusion

The lowering of the alcohol limits provided a valuable opportunity for the Bureau to review the methods used and the uncertainty applied to reporting alcohol levels. Uncertainties were calculated across the range for alcohol in blood and urine and breath. The Bureau has shown that above 50mg/100ml for alcohol in blood and urine and above 22µg/100ml in the case of EBT that a percentage deduction remains appropriate and below this level greater deductions are required to account for uncertainty associated with the test. This approach complies with ISO 17025 standard[8].

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Transporting young passengers while impaired and reckless: Examining driver and crash characteristics

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Abstract

Although drunk driving in the United States is a violent crime, driving impaired with a child in the vehicle is not typically acknowledged as child endangerment. The U.S. Department of Transportation and advocacy groups are struggling to improve public awareness of this issue, and recently, child-endangerment laws are receiving more attention. For this study, we examined the characteristics of drivers transporting young children who were alcohol-positive, speeding, or failed to obey a traffic signal at the time of the crash. Using the 1982-2010 Fatality Analysis Reporting System (FARS), we examined drivers aged 21 or older who were transporting young passengers (age <15 years). Approximately 21% of all fatally injured drivers who were transporting children were alcohol-positive (BAC>.00). The prevalence of these drivers has decreased over time, from 33% (1982-1986) to 19% (2006-2010). The proportion of women who were drinking and driving (with children in the vehicle) increased from 34.4% in 1982 to 47.1% in 2010. Although not statistically significant, the proportion also increased for speeding and traffic sign violations (red lights, traffic stops). These findings replicate those of previous studies showing an overall reduction in drinking and driving and an increase in drinking and driving among women (even when transporting children) in the past 28 years.

Background

Although drunk driving is a violent crime that leaves many dead or permanently disabled, driving impaired with a child in the vehicle is not typically acknowledged as child endangerment or abuse. Child-endangerment laws are intended to protect children from physical or emotional abuse, as well as victimization and being put in the way of harm. Driving impaired and/or recklessly with a child in the car falls under this definition, and it is a serious problem. For children aged 3 and up, motor-vehicle traffic crashes are the leading cause of death (National Highway Traffic Safety Administration, 2005). These crashes kill more children aged 1 to 15 than accidental drowning and exposure to smoke or fire combined. According to the Centers for Disease Control and Prevention (CDC, 2004), between 1997 and 2002, 9,622 child passengers died in motor-vehicle crashes, 24% (2,335) of which involved drinking drivers. Of these children, 68% were in the same vehicle as the drinking driver. More recently, Males (201) reported that from 1998 to 2007, nearly 12,000 children younger than age 16 were involved in fatal crashes where adult drivers (aged 21 and older) had a positive BAC test. Of these, 7,088 were injured, 2,444 had unknown injuries, and 2,307 were killed.

Beyond the injuries and fatalities caused by impaired drivers are those related to reckless and/or aggressive driving. According to a recent AAA report, between 2003 and 2007 approximately 56% of fatal crashes were attributed to aggressive driving, with excess speed being the number one factor (30.7%). Nearly one of every three fatal crashes involved a driver who was reported to have been exceeding the speed limit and/or driving too fast for the conditions. Statistics specific to child passengers were not found (AAA Foundation for Traffic Safety, 2009).

Aims

Using 1982-2010 statistics from the FARS, we assessed (a) the number of alcohol-related motor-vehicle crash (MVC) fatalities that involve children aged 14 and younger and (b) the number of MVC fatalities related to speeding and failing to obey a traffic signal.

Methods

Data used for this analysis came from the 1982-2010 FARS, which is a record system for all police-reported motor-vehicle crashes on U.S. roadways that result in the death of at least one road user within 30 days of the event. FARS provides detailed information about the fatally injured drivers' gender, age, level of alcohol consumption, and maneuvering skills. FARS also contains information about the number of vehicles involved in the crash and on passengers. We limited out sample by excluding buses, snowmobiles, and farm and construction equipment. Only passenger vehicles, minivans, pickups, sports utility vehicles, and 15-passengers vans were kept. We also excluded drivers who were mentally challenged, died while driving from a nondriving condition (e.g., a heart attack), police chases, and nonmoving traffic violations. Although information on race/ethnicity is available in the FARS, this information comes from death certificates (i.e., it is available for fatally injured occupants only) and available only since 1999 (Hilton, 2006). Therefore, race/ethnicity was not studied in this effort. The FARS also informs about the drivers' blood alcohol concentration (BAC). Alcohol, however, is tested on only a fraction of the drivers. In 1982, only 54% of the fatally injured drivers were tested. That figure climbed to 71% in 2009 (Casanova, Hedlund, & Tison, 2012). For those with no actual measure available, the FARS provides imputed BAC measures developed using a multiple imputation technique by Subramanian (2002). Imputed BACs are estimated from a battery of variables including the number of vehicles in the crash (single vehicle [SV] vs. multivehicle [MV]), injury severity (fatal vs. nonfatal), and the time of day. Because these variables were used to impute BACs, and an examination of their association with the BACs of the children's drivers is a goal of this effort, records with imputed BACs were excluded from this study. Among all drivers in the data set, there were 153,370 fatal crashes involving at least one child aged 0-14 years. In 33,587 cases (21.8%), at least one of the drivers tested positive for alcohol. Of the 54,665 children involved in alcohol-related crashes, 10,877 of them (about 20%) were fatally injured. Only drivers aged 21 and older driving at least one child younger than age 15 were included in our analysis. This ensured a minimum 7-year gap between driver and passenger, reducing the chance that the driver and passenger were peers. Of the 147,321 children in the file, a driver was transporting a child in 85,151 crashes. About 30% (25,764) of the crashes were SV and 70% (59,387) MV.

To systematize the analyses, the following age categories were examined for drivers: 21-25, 26-45, 46-65, and 66 years old. For children, the age categories were younger than 8, and 9-14 years old. The latter categorization served to explore if the child's age had any protective impact on the drivers' propensity to risk. We also examined the drivers' and passengers' gender. We hypothesized that female drivers would be more protective (take less driving risks) than their male counterparts. Also unknown was if the gender of the child had any protective (or risky) impact on the drivers' propensity to risk. To examine if both crash type and time of day had an impact (mediate and/or modify) the association between driver, children, and drinking and driving, we separately examined SV and MV crashes, for the following timeframes: 6 a.m. to 9:59 a.m.; 10 a.m. to 4:59 p.m.; 5 p.m. to 7:59 p.m., and 8 p.m. to 5:59 a.m. As mentioned, we limited our analyses to lab-tested BAC measures only. We studied three BAC levels: BAC=.00, .00<BAC<.08, and BAC≥.08. The latter signals the current maximum BAC threshold in per se laws in the U.S. Because impaired driving is not the only way drivers can endanger children, we also examined drivers' speeding and their failure to obey a traffic signal (e.g., red light, stop, or yield). We identified speeding drivers as well as those who failed to obey a traffic signal, as suggested in the *FARS Analytic Reference Guide* (NHTSA, 2010, p. V-81).

Analyses

The first analyses conducted were descriptive, bivariate statistics to examine dual associations between the variables of interest. Separately for SV and MV crashes, we estimated the distribution of children's injury severity, age, and gender, as well as the drivers' age and gender for crashes in which the driver was at BAC=.00, 0<BAC<.08, or BAC≥.08; speeding; or failed to obey a traffic signal. We looked at point estimates and examined their 95% confidence intervals to compare across the different crash types. For these analyses, we used SAS 9.2 software.

Results

Table 1 provides a basic description of the data file, informing separately about the characteristics of the children and their drivers, as well as the time of day of the crash. About 30% of the 85,151 crashes were SV crashes, and about 70% were MV crashes. For both SV and MV crashes, most occurred between 10 a.m. and 4:59 p.m.: 33.3% of SV, 44.9% of MV crashes. However, among SV crashes, another third (31.6%) occurred between 8 p.m. and 5:59 a.m. Interestingly, about half of the MV crashes with children occurred at daytime, whereas SV crashes were more evenly distributed between daytime and nighttime. This may be related to the well-established association between alcohol and SV crashes, which tend to be higher at nighttime (Rodgers, 1995; Voas, Romano, & Peck, 2009).

The majority (65.5%) of drivers transporting children were aged 26 to 45, with 80.5% being aged 26 to 65. Slightly over 16% were aged 21 to 25. Unlike any other age category, the proportion of drivers aged 21 to 25 was higher among SV crashes (19.2%) than among MV crashes (14.8%). Over 53% of drivers were male. The proportion of males driving children was higher in MV crashes (55.7%) than in SV crashes (47.9%). That association, however is reversed for women, with the proportion of female drivers with children significantly higher in SV crashes (52.1%) than in MV crashes (44.3%). Such a difference might be associated with gender-based differences in drinking-driving patterns, with men more likely to drive alone after drinking, and women more likely to be found driving a child after drinking.

In the crashes we examined, 147,321 children were passengers, yielding an annual average of 5,261 children aged 0-14 involved in crashes in which the driver was aged 21 and older. Of the 147,321 children in the file, 18.0% were fatally injured. The percentage of fatally injured children was significantly higher among SV crashes (19.9% of all children) than among MV crashes (17.2%). Among the children in the sample, the majority (63.5%) were between the ages of 0 and 8 years. The age distribution of the children in the file was similar in both SV (62.9% vs. 37.1%) and MV crashes (63.8% vs. 36.3%). Interestingly, in looking at the gender of the children, the proportion of boys was slightly (but statistically significant) higher than that for girls in both SV and MV crashes although there was a less than 2% difference in the number of boys in crashes than girls.

Table 1. Descriptive analyses

				SV	MV	All
Time of the day	Crashes		N=	25,764	59,387	85,151
	6 a.m. - 9:59 a.m.		N=	3,318	6,705	10,023
			%	12.9%	11.3%	11.8%
			CI	*12.5% 13.3%*	*11.1% 11.5%*	*11.5% 12.0%*
	10 a.m. - 4:59 p.m.		N=	8,582	26,641	35,223
			%	33.3%	44.9%	41.5%
			CI	*32.7% 33.9%*	*44.5% 45.3%*	*41.2% 41.8%*
	5 p.m. - 7:59 p.m.		N=	5,735	13,724	19,459
			%	22.3%	23.1%	22.9%
			CI	*21.8% 22.8%*	*22.8% 23.5%*	*22.6% 23.2%*
	8 p.m. - 5:59 a.m.		N=	8,129	12,317	20,445
			%	31.6%	20.7%	23.9%
			CI	*31.0% 32.1%*	*20.4% 21.1%*	*23.6% 24.2%*
Drivers	Drivers		N=	25,764	62,701	88,465
	Age	21-25	N=	4,952	9,299	14,250
			%	19.2%	14.8%	16.1%
			CI	*18.7% 19.7%*	*14.6% 15.1%*	*15.9% 16.4%*
		26-45	N=	16,556	41,345	57,901
			%	64.3%	65.9%	65.5%
			CI	*63.7% 64.8%*	*65.6% 66.3%*	*65.1% 65.8%*
		46-65	N=	3,506	9,719	13,225
			%	13.6%	15.5%	15.0%
			CI	*13.2% 14.0%*	*15.2% 15.8%*	*14.7% 15.2%*
		66+	N=	750	2,339	3,088
			%	2.9%	3.7%	3.5%
			CI	*2.7% 3.1%*	*3.6% 3.9%*	*3.4% 3.6%*
	Gender	Male	N=	12,338	34,924	47,263
			%	47.9%	55.7%	53.4%
			CI	*47.3% 48.5%*	*55.3% 56.1%*	*53.1% 53.8%*
		Female	N=	13,426	27,777	41,202
			%	52.1%	44.3%	46.6%
			CI	*51.5% 52.7%*	*43.9% 44.7%*	*46.3% 46.9%*
Children	Children		N=	44,483	102,838	147,321
	Fatal Injury		N=	8,852	17,678	26,530
			%	19.9%	17.2%	18.0%
			CI	*19.5% 20.3%*	*17.0% 17.4%*	*17.8% 18.2%*
	Age	0-8	N=	27,998	65,559	93,557
			%	62.9%	63.8%	63.5%
			CI	*62.5% 63.4%*	*63.5% 64.1%*	*63.3% 63.8%*
		9-14	N=	16,485	37,279	53,764
			%	37.1%	36.3%	36.5%
			CI	*36.6% 37.5%*	*36.0% 36.5%*	*36.3% 36.7%*
	Gender	Male	N=	22,927	52,087	75,014
			%	51.5%	50.7%	50.9%
			CI	*51.1% 52.0%*	*50.4% 51.0%*	*50.7% 51.2%*
		Female	N=	21,556	50,751	72,307
			%	48.5%	49.4%	49.1%
			CI	*48.0% 48.9%*	*49.0% 49.7%*	*48.8% 49.3%*

Table 2 examines the joint children-driver association, in particular fatally injured children being transported by drivers who had used alcohol and/or drove recklessly (as identified by speeding and failure-to-obey infractions). About 21.3% of all children with a driver tested for alcohol were fatally injured, which was not statistically different between SV and MV crashes. Further, 2,473 (i.e., 218+2255) children were killed in crashes with alcohol-positive drivers. Differences between SV and MV crashes surfaced regarding the percentage of children killed by BAC≥.08

drivers. Among SV crashes, 34.5% of the drivers of fatally injured children were at BAC≥.08, a proportion significantly higher than the 14.9% among MV crashes.

Table 2. Fatally injured children by driver's BAC level

	SV		MV		All	
All Fatally injured children	8,840	17,643	26,483	8,840	17,643	26,483
Fatally injured Children with alcohol-tested drivers	3,490	20.0%	7,031	22.1%	10,521	21.3%
% driven by a BAC=0 driver	2215	63.5%	5833	83.0%	8048	76.5%
% driven by a .00<BAC<.08 driver	70	2.0%	148	2.1%	218	2.1%
% driven by a BAC≥.08 driver	1205	34.5%	1050	14.9%	2255	21.4%
Fatally injured Children with drivers with information on speeding	8,826	99.8%	17,637	100.0%	26,463	99.9%
% driven by a speeding driver	2940	33.3%	1999	11.3%	4939	18.7%
Fatally injured Children with drivers with information on failure to obey	8,840	100.0%	17,643	100.0%	26,483	100.0%
% driven by a driver who failed to obey a traffic signal	498	5.6%	3697	21.0%	4195	15.8%

A total of 4,939 children were killed in a crash where their driver was speeding. The percentage of children killed by a speeding driver varied between SV crashes (33.3%) and MV crashes (11.3%). For failure to obey crashes, the prevalence reversed, being smaller for SV crashes (5.6%) than for MV crashes (21.0%). Thus, Table 2 shows a close association between children's fatalities in SV fatal crashes and alcohol and speeding, whereas children's fatalities in failure-to-obey crashes were more associated with MV crashes. These findings suggest some sort of deleterious synergism between alcohol and speeding among SV crashes. Further analyses looking at the distribution of drivers by BAC and speeding revealed that, although most nonspeeding drivers were at BAC=.00 (SV crashes, 75.3%, or MV crashes, 86.5%), about 45% of those who sped in SV crashes were at BAC≥.08 (26.2% in MV crashes).

Table 3 shows that the percentage of female drivers of fatally injured children who were alcohol-positive, speeding, or failed to obey increased from 1982 to 2010 (statistically significant only for BAC>.00 crashes).

Table 3. Fatally injured children: % Female Drivers in selected years

	BAC>.00			Speeding			Failure to Obey		
YEAR	**%**	**L95%CI**	**U95%CI**	**%**	**L95%CI**	**U95%CI**	**%**	**L95%CI**	**U95%CI**
1982	34.4	30.3	38.7	41.7	34.2	49.1	48.1	40.4	55.9
1987	38.1	33.2	43.1	53.9	46.0	61.9	52.3	43.7	61.0
1992	43.8	38.8	48.8	48.2	40.7	55.8	60.5	53.0	68.0
1997	46.5	41.8	51.1	47.5	40.6	54.4	57.1	50.1	64.2
2002	39.5	34.6	44.4	42.2	35.2	49.2	56.1	48.1	64.1
2007	39.2	33.7	44.8	54.1	46.6	61.6	57.5	48.1	67.0
2010	47.1	40.9	53.2	48.1	39.5	56.7	67.2	55.7	78.7

Discussion

For alcohol-related crashes and crash type, our analyses reveal that the likelihood of finding an alcohol-impaired driver with a child passenger was similar to that of the general population of drivers. For example, although the majority of MV crashes occurred during the daytime, SV crashes were evenly distributed between day and night. SV nighttime crashes also tended to be associated primarily with drinking and driving as well as with speeding, whereas MV crashes tended to occur during the day and were less associated to drinking or speeding, but rather failure to obey. Further, we found male drivers to be more likely to drive at night (female drivers at daytime), a pattern that mimics those found in the general population of drinking drivers. However, despite crash and characteristic patterns similar to the general population of crashed drivers, the prevalence of BAC≥.08 drivers is lower among those driving with a child than among other drivers. This may suggest that the presence of a child serves as a protective factor against impaired driving. People may choose not to drink when they are driving young children.

Yet, among drivers who do transport a child after drinking, probing into the characteristics of drivers and their crashes reveals some interesting findings. As noted, most drinking drivers were men, a finding that matches those of the general population. Interestingly however, we also found that among SV crashes (which tend to be associated with DUI), most drivers with children were women. This is reversed among MV crashes. This finding, coupled with the increased involvement of women in crashes involving children, may be related to the different general societal roles of men and women: women tend to be the main care provider that requires them to drive with their children. Unfortunately, the database we used does not allow for a complete examination of this speculation. It does provide evidence to encourage further research.

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A qualitative investigation of drug use among Pakistani road users

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Abstract

Background
Statistics on drug use by Pakistani drivers are not available, yet considerable numbers of drivers are believed to be drug addicted. The National Drug Abuse Assessment 2006/07, conducted by the United Nation Office on Drugs and Crime and the Ministry of Narcotics Control Pakistan reported that opiate users numbered 628,000, of which 77%were chronic heroin abusers. Injecting drug users have reportedly doubled in the decade to 2006 and drug use has been linked with many major crashes involving professional drivers.

Aims
This study explored a broad range of risk taking behaviours of road users, including drug use. It also investigated associations between risky road use and fatalism and other cultural beliefs.

Methods
This paper reports findings relating to drug driving in the cities of Lahore, Rawalpindi and Islamabad. Thirty semi-structured interviews were conducted with bus, truck, and taxi drivers, policy makers and field police officers.

Results
Interviews suggested widespread use of illicit drugs, particularly among bus, truck and taxi drivers. Reasons for drug use included recreational purposes, stimulants during long driving episodes, and substance addiction. Furthermore, the use of drugs and any association with road crashes was generally viewed as linked to fatalism rather than to any fault of an individual. In other words, people did not believe there was an association between drug use and road crashes, even if they had personally experienced such. Police knowledge of drug use among drivers was evident, although there is no formal drug driving testing regime in Pakistan.

Discussion and conclusions
The substantial increase in drug use among the population in recent years highlights a significant public health challenge in Pakistan. This qualitative research, although recognized as not representative of the broader population, suggests that there is significant cause for

concern about drug driving, especially among professional drivers, and a need for further investigation and intervention.

Introduction

Pakistan is located next to Afghanistan, the world's largest producer of illicit opium. This puts Pakistan in a vulnerable position in terms of drug availability and abuse (Zafar & ul Hasan, 2002). The little information available on drug use in Pakistan is summarised below. However, comprehensive statistics on drug use by Pakistani drivers are not currently available.

Survey data on drug use in Pakistan

Every year at least 50,000 more people become addicted to different kinds of drugs in Pakistan (Ministry of Narcotics Control Pakistan, 2011; The Express Tribune, 2011). The number of drug users in Pakistan has gone up from 50,000 in 1980 to 6.2 million in 2006 and 8.1 million in 2011 (Ministry of Narcotics Control Pakistan, 2011). It is estimated that 1 in 27 adults in Pakistan are dependent on drugs (UNODC, 2013). Compared to the 1980s when there was virtually no heroin use in Pakistan, the 1990s witnessed a growing heroin epidemic (Khawaja et. al., 1997). As a proportion of drug abusers, heroin users increased from 7.5 % in 1983 to a shocking 51% in 1993 and 77% in 2006 (Anti-Narcotics Department Pakistan, 2006; UNODC, 2010). The Ministry of Narcotics Control, Pakistan, the Bureau of Statistics, Pakistan, and the United Nations Office on Drugs and Crime released a collaborative technical summary report in 2013 on drug use in Pakistan. This report confirmed that cannabis is the drug most commonly used by Pakistanis aged 15 to 64 (3.6 per cent of the population, or approximately four million people). Opiate use (heroin or opium) is also widespread with one per cent of the population (one million people) using it. Similarly opioid-based painkiller misuse is also high, involving 1.5 per cent of the population, or nearly 1.7 million people (UNODC, 2013). According to the National Drug Abuse Assessment 2006/07 survey, most of the opioid users were multiple or poly drug users, i.e., they were using more than one substance at a given time or during a day. Therefore many opioid users were using tranquilizers, antihistamines, and other opiates along with heroin as their primary drug of abuse.

Drug use and driving in Pakistan

There is a very little research on drug use among drivers in Pakistan in relation to road safety. However, indirect information from sources such as police and media reports as well as studies in other fields such as HIV/ AIDS (i.e. Khawaja et. al., 1997; Ahmed et. al., 2003; Haque et. al., 2004) suggest a common use of drug related substances among drivers, particularly professional drivers. Mir et al. (2012) conducted a study on alcohol and marijuana use while driving on a sample of 857 commercial bus and truck drivers recruited from the largest commercial vehicle stations in Rawalpindi and Islamabad. Results revealed that almost 10% of truck drivers reported using alcohol, with higher usage reported by truck than bus drivers. Marijuana use was reported by a larger proportion of drivers than was alcohol. Approximately 23% of the sample reported marijuana use, and proportions were higher among truck (30%) than bus drivers (14.7%). The use of alcohol and marijuana together was reported by a smaller proportion (4.6%), and approximately 8% reported use of stimulant pills when driving. With regard to crash history, the study revealed that a greater proportion of crash-involved drivers (previous 5 years) reported using marijuana than those reporting no crash involvement (30% and 22%, respectively).

Aims

The findings reported in the current paper were drawn from a larger study that explored a broad range of risky road use behaviours. It also investigated associations between risky road use and fatalism and other cultural beliefs. Along with other factors, drug use was mentioned during participant interviews. Therefore, the current paper is focused on extracting the information on drug use and driving, including drug use in general. Specifically, the aim of the current study was to explore reported drug use by professional drivers and the impressions that other groups (including police) had about the significance of drug use among professional drivers.

Methods

Qualitative research was undertaken by the first author in the cities of Lahore, Rawalpindi and Islamabad. Thirty semi-structured interviews were conducted with bus, truck, and taxi drivers, policy makers and field police officers. The professional drivers were recruited primarily at depots, and the other groups were recruited using a mix of convenience and snowball sampling. The interviews were recorded and transcribed in Urdu, and then translated into English. The English transcripts were then analysed thematically. As noted above, the data cited here form a subset of those transcripts where drug use was explored.

Widespread use

Participants believed drug use was widespread and acknowledged their own use:

> Interviewer: "How many heavy vehicle drivers you think use drugs while driving?"
> "Many drivers use them. About 60 to 70 percent use them."
> Interviewer: "Do you use drugs?"
> "Yes, I use drugs while driving." (During the interview he was smoking a heroin cigarette). **Bus driver, middle school education, 39 years old, male**
>
> Interviewer: "Do drivers use drugs while driving?"
> "75% of drivers use drugs in bus, long trailer and truck drivers. I also used to use heroine and chars (cannabis). If you do not believe me so wear clothes like me (look like a driver) and I will give you proof (to see how frequent it is)." **Bus driver, no education, 48 years old, male**
>
> Interviewer: "Some heavy vehicle drivers use drugs, what is their percentage in your view?"
> "I think 90% of heavy vehicle drivers use drugs, especially on long routes." **Police officer, Masters degree, 32 years old, male**

Recreational drug use and drug use to avoid sleepiness

In some cases drug use while driving was reported as being for recreational use, at least in part:

> Interviewer: "Why do you use them? What are the benefits while driving?"
> "It's for recreational purpose and we become a human (i.e. feel normal, confident and in control). I do it too for relaxation purpose." **Bus driver, no education, 48 years old, male**

Not surprisingly, professional drivers spoke of drug use as being necessary to stay alert. Moreover, there appeared to be a belief that opiate use will assist alertness, in contradiction to its known pharmacological properties:

> Interviewer: "Have you ever used drugs while driving?"
> "Yes sometime we use them so that we don't have sleep and tiredness, and police does not also watch us at night." **Taxi driver, Middle School Education, 32 years old, Male**
>
> "I think it is good (to use drugs). Drivers use drugs because they make them active. It becomes a habit. To avoid sleep on long routes they use drugs, which make them active."
> Interviewer: "But I've seen a road accident at ChichaWatni City Bridge in which the driver used heroin and about 50 people died."
> "I'm telling you from my experience (of using drugs) that heroin makes you active. It is my experience of whole life that if he had used the heroin he would not have had this accident. It would've been unavailability of heroin to that driver which has led the driver to sleep. Like when you eat food it gives you energy, likewise addicts get their energies back from drugs." **Truck driver, Primary School, 49 years old male**

One police officer reported the belief that recreational drug use was really about maintaining alertness, although the wording used suggests that the local conceptualization of alertness differs from the standard road safety approach (associating "numbing" of the mind with reducing fatigue):

> "Driving for too many hours make them use drugs. They want to make their mind numb so that they do not feel tiredness. It is not usually enjoyment." **Police officer, Masters degree, 32 years old, male**

Substance addiction
As might be expected, drivers did not directly acknowledge addiction, although their reports of repeated patterns of use suggest it. There were some responses that indicated that drivers felt there was no choice, implying that addiction is a factor:

> Interviewer: "You already stated that you had confronted many road accidents in which many people died. You were also injured. But still as you said drive under drugs and carelessly. Do you not think for yourself and other passengers in the bus? Their life is also in danger?"
> "But I do sometimes when I have to do it."**Bus driver, no education, 48 years old Male**
>
> " The government should control this (drug use while driving) because people are addicted to such habits." **Truck driver, middle school, 40 years old, male**

Fate causes crashes, not drugs
Elsewhere we have reported on the pervasiveness of fatalism concerning road crashes in Pakistan (Kayani, King & Fleiter, 2012). This applied to drug use as well:

> Interviewer "Why do you do this (use drugs while driving)? Do you think about road accidents that you might face?"
> "It's God who protects us."**Bus driver, no education, 48 years old, male**

Legislation and enforcement
As the quotes above indicate, police are aware of the problem:

> "The majority of drivers use drugs while driving. Those that use drugs are a curse. Drugs users think they will not feel sleepy. To escape tiredness and sleep they use them." **Police officer, matriculation level schooling, 52 years old, male**

However legislation and resource constraints mean that drug use while driving receives little police attention. As the taxi driver cited earlier observed, police activity at night is quite low.

Summary of results
The use of drugs was considered by professional drivers to have beneficial effects on alertness, at least under some circumstances. Any association with road crashes was generally viewed as linked to fatalism rather than to any fault of an individual. In other words, people did not believe there was an association between drug use and road crashes, even if they had personally experienced such. Police knowledge of drug use among drivers was evident, although there is no formal drug driving testing regime in Pakistan.

> "The majority of (truck) drivers use drugs while driving. Those that use drugs are a curse. Drugs users think they will not feel sleepy. To escape tiredness and sleep they use them. They are harmful for health."**Police officer, Matric schooling, 52 years old male**

Discussion and conclusions
Drug use data indicate that there has been a substantial increase in drug use among the population in recent years. This is a significant public health challenge in Pakistan in its own right, and our results (while qualitative and utilising a non-random sample) suggest that it is a significant issue among professional drivers as well. The findings are also consistent with the limited previous research conducted among commercial drivers in Pakistan (Mir et al., 2012). There appears to be widespread use of illicit drugs among bus, truck and taxi drivers, for recreational purposes and to combat fatigue, although the rationale for the stimulant effects of opiates is not consistent with their known pharmacological effects. Addiction is likely to be involved as well.

Addressing the problem presents several challenges. Police are aware that drug driving is an issue, but lack the resources and probably the legislative framework that would enable them to pursue enforcement to reduce drug driving. Many drivers themselves are fatalistic (Kayani et al., 2012), which means that it is difficult to convince them of the link between drug use and crash risk. There is clearly a need for further investigation and intervention.

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Testing the Evidenzer Mobile 240 for evidential use in Norway

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Abstract

Background
In Norway a legal limit for alcohol in blood was introduced in 1936. Since 1996 evidential breath tests have been performed with Intoxilyzer 5000N.
In 2011 Evidenzer replaced the old instruments according to requirements based on OIML R126 and national demands.
Before introducing the new instrument it we documented its performance capabilities. Different areas of application were checked with the old instrument as the standard.

Method
The following test sequences were run: Laboratory tests/in vitro (approx 1600), Controlled tests/in vivo (approx 400) and Field tests (approx 350). The main areas for testing were accuracy, precision, linearity, reproducibility, specificity, functionality, user-friendliness and reliability, as well as necessary and relevant control- and safety functions.
19 randomly selected persons were tested in a controlled drinking study.

Results
In most of the critical areas Evidenzer is better than or on the same level as Intoxilyzer.

Some selected results:
For accuracy the deviation below 0.40 mg/L was determined to 0.007 mg/L.
The precision below 0.40 mg/L was calculated to 0.0016 mg/L and above 0.40 mg/L to 0.3 %.
Specificity tests showed that up to 0.25 mg/L substances that can be found in human breath are either flagged or subtracted.
The average observed breath temperature in the Norwegian tests were 34.58 ^{0}C , while the same values in a Danish reference material were 35.15 ^{0}C.
A controlled drinking study showed that the average metabolism of alcohol with Evidenzer was 0.077 mg/L/hr.

Conclusion
The performed validation showed that Evidenzer Mobile 240 is well suited for evidential documentation of DUI also in the area around low legal limits (0.1 mg/L).

Introduction

Norway has a long tradition for controlling drunk drivers. In 1912 the first law on the subject was introduced, stating among other things that “Drivers must not be intoxicated”. In 1930 clinical examination by medical personnel was established, and 5 years later it was decided that such an examination must include a blood sample. The year after we got the first legal limit.

People were to be considered as intoxicated if they had more than 0.5 ‰ alcohol in their blood. In 1950 screening with alcometer and chemical tests for alcohol were introduced.
In 1988 the law got an option for breath testing. The legal limit for intoxication when alcohol was measured in exhaled air was established to 0.25 mg/L. The first generation of evidential breath testing instruments (Intoxilyzer 5000N - 68 series) was taken into service in 1996.
In 2001 the legal limits were lowered to respectively 0.2 ‰ in blood and 0.10 mg/L in breath.
In 2012 our old evidential breath instruments had reach their retirement age. So a process was started to find new instrument. It must however be said that Intoxilyzer 5000N given the appropriate care, still were able to serve as reliable and accurate evidential instruments.

After a procurement process a chose was made for the new instrument Evidenzer Mobile 240 developed and produced by Nanopuls in Sweden.

Validation

Evidenzer Mobile has been validated against Intoxilyzer 5000N in different areas of application. The old instrument has through more than 15 years proven to be reliable and exact, and has therefore been selected as the standard. Intoxilyzer 5000N has earlier been validated against blood samples in order to establish a traceable link from breath alcohol to blood alcohol.
The basis for validating the test results has been the demands in OIML R126 and in our national Specification for requirements. In most aspects the national demands have been set stricter than the ones in OIML.
Main validation areas were: reliability, accuracy, precision, linearity, reproducibility, specificity, functionality, user-friendliness, control- and safety functions. In addition we also looked into breath temperature and back-calculation.

Experiments

Six main series of experiments were performed. They have been named according to where and when they took place. The details of these were as follows:

Laboratory testing/In vitro.

”Uppsala 2010”
Functionality, reliability, accuracy, reproducibility, specificity and temperature of exhaled air were tested. Four Evidencers and four Intoxilyzers were used.
A total of approximately 1 600 tests were run.

Controlled Testing/In vivo.

”Stavern 2011”

18 random selected persons of both sexes and with a wide range of age and bodyweights were tested. Controlled drinking up to an alcohol level in breath of max 0.3 – 0.4 mg/L. They were then tested on both instruments every 15. minute until no alcohol readings were registered.
We also tested for mouth alcohol, blow pressure/manipulations and temperature of exhaled air.
A total of approximately 300 pairs of results were obtained.

”Control 2012”

Three Evidenzers with different versions of software were used. The main goal was to see if some minor changes in the software parameters had any influence on the test results.
Two persons drank alcohol. They were then tested on all three instruments until no alcohol readings were registered. The waiting time between the three instruments were reduced as much as possible.
Tests were also made for manipulation (hyper-/hypo ventilation) and temperature of exhaled air.
A total of 72 tests were run.

Field Tests

”Brandbu 2011”

A number of randomly selected volunteers were tested on both instruments in a social setting. All aspects of the validation areas were checked in addition to the temperature of exhaled air. The order of the tests was varied.
A total of 79 pairs of results were obtained.

”Sarpsborg 2011”

A number of randomly selected volunteers were tested on both instruments in a social setting. All aspects of the validation areas were checked in addition to the temperature of exhaled air.
A total of 46 pairs of results were obtained.

”Field 2011-2012”

These tests were made during ordinary police controls in local police stations. 15 sets of instruments were used. Intoxilyzer was always used first since this was the only approved evidential instrument. All aspects related to a real testing situation were checked in addition to the temperature of exhaled air.
A total of 225 pairs of results were obtained.

Results

Accuracy and precision

Accuracy and precision were expressed through real deviation and standard deviation. Calculations have been made based on the results from 10 samples run with 6 different alcohol standards (0.00 – 0.10 – 0.25 – 0.50 – 0.79* - 1.00 mg/L). When the results were used for calculations, it was discovered that the results obtained with the standard meant to be 0.75 were not consistent with the others. After controlling it was ascertained that it had been wrong prepared and that the “true” value was somewhat higher. Back-calculations afterwards indicated the value to be around 0.79 mg/L, but this is probably too high
Test gas (simulated breath test) was generated with a test equipment called ProfilerTM *Lite*.

Two simulators were connected in series and the reference solutions were thermally stabilized for 2 hours before start. The Profiler is programmed to imitate a natural exhalation profile from a human being with alcohol concentration as function of time.
According to the results the Evidenzer has better accuracy and precision than Intoxilyzer, and are within the limits of both the demands in OIML and our own Specification of requirements.

Linearity

An evidential instrument is meant to be able to measure over a wide range of alcohol concentrations, and the demand refers that it must show "the right value" over the whole scale. A certain un-linearity will normally always be registered at high levels, but this is usually accepted. The tests show that Evidenzer has a good linearity. The instrument indicates in general a somewhat lower result than the "true value", and no results are higher than this. The deviation is less compared to Intoxilyzer in the area from 0.0 to 1.0 mg/L, and highest at high values.

Reproducibility

Reproducibility means that the instrument shall give the same result within the limits of statistical variations when the same sample is run several times. This should apply to the whole measuring range. The reproducibility of Evidenzer is consistent with the demands given.
An important issue is the so-called "memory-effect" which means that one sample should not be influenced by the previous one(s). This is in particular relevant when changes are made from high to low concentrations. "Memory-effects" have not been registered during the validation tests. This apply without having compensated for the impoverishing of the testing material (references) normally taking place when repeated in vitro tests are run within a short period of time.

Specificity

Evidenzer has been tested at three different alcohol concentrations (0.00 – 0.10 – 0.25 mg/L) mixed with the following "interfering substances": acetaldehyde, acetone, diethyl ether, ethyl acetate and a mixture of acetaldehyde/acetone.
The selection of "interfering substances" has been based on knowledge with what is most probable to be present in a person's exhaled air, as well as what according to theory/chemical structure, are most likely to represent the biggest challenges for the detection technology inside the instrument.
The quantities of "interfering substances" have been selected in a way so that all concentrations should give approximately the same response from the IR-detector. It means that the instrument will „flag" when the content in the gas stream is equivalent to about 2 volume percents of the total test volume. This is considerably less than saturation at room temperature.
The test gas (simulated exhalation) is generated with the testing equipment called Profiler™ Lite. It has the options for the supply of an adjustable and controllable quantity of "interfering substance". In this way it is possible to test the deductions the instrument is supposed to make, as well as the "flagging" function when the concentration becomes to high. The testing starts with approx 1 % supply from the "contaminated" plastic bag and is then throttled gradually until "flagging" ceases. All tests were run on 4 different instruments.
The results show that none of the tested substances provide a false reading as alcohol when alcohol is not present in the exhaled air. The same goes for the real alcohol concentrations. If an

“interfering substance” is present the instrument will “flag” (render a fault message) and subtract more than an eventual contribution from the “interfering substance”. If the contribution from the “interfering substance” is so modest that the instrument does not “flag”, the alcohol result is not affected in a degree worth mentioning.

Mouth alcohol/observation time

Mouth alcohol is detected both by analysing of the profile of the ethanol curve (curve-analysis) and by comparing the two partial samples delivered with at least 2 minutes waiting time (difference-analysis).
The curve-analysis consists of two elements. The elevation of the curve (Rise) from 1.5 seconds after blowing has started until the end is determined. At the same time the stability of the curve shape is determined.
By introducing a long waiting time between the two partial samples and optimizing the curve- and difference-analysis, it is possible to drop the observation time prior to a test is performed. The two control functions will then have to be adjusted in such a way that they detect all real cases of mouth alcohol.
The occurrence of mouth alcohol in the data from the tests seems statistically to be overrepresented. This is probably due to incorrect calibration levels.
Tests where mouth alcohol has been simulated in controlled drinking experiments have also been performed. The instruments have then warned with a fault message as expected.

Functionality/user-friendliness

An inquiry amongst the operators (police officers) in charge of the tests performed during the Field experiments revealed that 88 % of them were satisfied (good + very good) with the instrument’s functionality and user-friendliness in general. What scored lowest was the keyboard which is a standard version and not one of the modern touch-screens you today can find on most electronic consumer goods.
Among the positive comments these were most frequent:

- Very user friendly
- Small and light/reduced blowing resistance
- Spares us the long observation time
- A very positive general impression
- Much easier to use than Intoxilyzer
- Easier to blow, no observation time and easy to use
- More convenient instrument

Breath temperature/Body temperature

The average value for all registered temperature readings from the Norwegian test series is 34.58 ^{o}C (min 28.90 – max 37.67), while the corresponding value for samples from Denmark is 35.15 ^{o}C (min 29.70 – max 37.50). The cause for this discrepancy is not known, but assumed to be related to the calibration of the temperature sensors or to the way the tests have been performed. It is also evident that the temperature of the second exhalation is consistently higher than the first one. The difference is between 3 and 4 %.

An increased body temperature will normally result in a similar increase of the temperature of the exhaled air and an increase of the passage/evaporation of the alcohol from blood to breath in the deeper part of the lungs.
Limited previous experiments have indicated that an increase in body temperature of 1 ^{o}C may result in an increase of the alcohol concentration in the exhaled air of up to 10 %.
Since Evidenzer has a temperature sensor built into the blowing tube, we wanted to test if an increased temperature led to an elevated alcohol reading.
Three alcohol solutions (0.00 – 0.10 – 0.25 mg/L) were tested at 6 temperatures (34, 35, 36, 37, 38, 39 ^{o}C) with a test equipment (Simulator^{ET}) that produced wet gas saturated with vapour.
The results increase with increasing temperature for those samples containing alcohol. At a concentration of 0.10 mg/L the increase is 22.1 % when the temperature is increased by 5 ^{o}C (4.4 %/degree), and likewise 31.1 % (6.2 %/degree) at a concentration of 0.25 mg/L. Compensation for impoverishing of the standards has not been done.

Manipulation by breathing techniques

Previous practice has revealed that the result of a breath test can be manipulated by intentionally breathing. By hypoventilation a higher reading can be obtained, while by hyperventilation the reading can be lowered.
In a real situation it is assumable that only hyperventilation is relevant. Evidenzer was tested in vivo at low alcohol concentrations (up to 0.2 mg/L). Hyperventilation was performed either before the first or the second partial blowing in order to reduce the effect of metabolism.
Compared to ordinary tests (without hyperventilation) it revealed that very intense and deep hyperventilation could reduce the reading in average with around 7 %. At the same time the breath temperature was reduced by an average of 0.8 ^{o}C.

Metabolism/Back-calculations

Randomly selected persons (10 men and 9 women) were given alcohol, respectively beer, red wine or vodka in adjusted doses that, based on individual body weights should result in an alcohol concentration in the blood of about 0.7 – 0.8 ‰.
The candidates were tested then every 15. minute until no positive readings were done.
The experiments showed that the instruments function as expected. The alcohol curves (metabolism as a function of time) for all candidates seem to be in accordance with what can be found when blood samples are drawn and analysed. In the phase of declining intoxication (1-2 hours after alcohol intake) this can intimate an average rate of metabolism.
The average rate of metabolism for the persons tested was 0.077 mg/L for both instruments.

Conclusion

The validation experiments have shown that concerning essential features the Evidenzer Mobile 240 fulfils the international demands (OIML) set for instruments intended for evidential alcohol testing, as well as the Norwegian spec.
Evidenzer Mobile 240 is in most of the critical areas better than or on the same level as Intoxilyzer 5000N.
Evidenzer Mobile 240 is well suited for evidential documentation of DUI also in the area around low legal limits (0.1 mg/L).

The road traffic risk of different offender groups after licence reinstatement

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Abstract

Background
In Germany, courses for the restoration of the fitness to drive after licence revocation are provided for different offender groups (alcohol, drug and demerit point offenders). Providers of these courses are by law required to prove the effectiveness of the applied course programs. For the evaluation of effectiveness, the Federal Highway Research Institute (BASt) established specific "Reference Values" in 2002.

Aims
The objective of the study at hand was to collect valid data in order to renew the old-established Reference Values from 2002. Additionally, data collection aimed at initializing Reference Values for drug offender programs.

Methods
Over 66,000 drivers were analysed regarding their traffic probation in the three years after licence reinstatement. Offenders were assigned to an offender group (alcohol, drugs and demerit point offenders) based on the reason for prior licence revocation. Different indicators were used as criteria for re-offending: new alcohol or drug records, culpable accident involvement and repeated licence revocation. For each of the offender groups, frequency distributions regarding these indicators were calculated.

Results
Frequencies of recidivism are highest for the group of demerit point offenders. Compared to the Reference Values of this group from 2002, frequencies of re-offending increased. Conversely, re-offence frequencies of alcohol offenders are halved compared to the data from 2001. The analysis of the re-offence frequencies of drug offenders reveals an equal amount of re-offenders as in the alcohol offender group.

Discussion and conclusions
The collected data serve as a good base for renewal of the old-established Reference Values and may be applicable as comparative data for future evaluations The results reveal significant differences between recent data and earlier studies. These may occur due to improvements of the applied programmes, but also due to situational changes, e.g. increased enforcement levels and expansion of the catalogue of offenses which lead to demerit points.

Introduction

Courses for the restoration of the fitness to drive of traffic offenders ("Section70-courses")

Psychological rehabilitation measures for traffic offenders with deficits in the fitness to drive have been applied in Germany since the beginning of the 1970s. Before these courses were definitely implemented into the legal system, their effectiveness had to be proven (Winkler, Jacobshagen & Nickel, 1988).

With the implementation of the Driving Licensing Regulation (Fahrerlaubnisverordnung, FeV) in 1999, courses for the restoration of the fitness to drive gained the necessary legal frame: Section 70 FeV states that the Supreme Authority of the Federal State may authorize course programs for the restoration of the fitness to drive in case of meeting the following requirements:

- the course program is based on a concept with scientific background,
- the suitability of the course program is approved by an independent scientific expert opinion,
- the course leader provide evidence for
  - an academic degree in psychology,

  [...]
- the effectiveness of the course program is approved according to the state of the art (evaluation)
- [...] (Section 70 FeV)

This section furthermore requires re-evaluation of the course program every 15 years.

Course programs are offered target group-specific for alcohol offenders, drug offenders and demerit point offenders. In most cases, these offenders have to pass a Medical-Psychological Assessment prior to licence reinstatement (for details see Boets, Meesmann, Klipp et al., 2008; Klipp, Escrihuela-Branz, Boets et al., 2009). As one result of this examination (in addition to negative or positive results), participation in one of these so called “Section70-courses” may be recommended. The licensing authority has to give an additional permission for each offender that allows him/her to participate. The successful participation in a Section70-course has legal consequences: the driving licence is reinstated without any new assessment or additional obligations.

Evaluation of course programs

Section70-course providers are by law required to prove the effectiveness of the applied course program in order to gain authorization from the Supreme Authority of the Federal State. Hence, the Federal Highway Research Institute (Bundesanstalt fuer Strassenwesen, BASt) published official guidelines for the evaluation of program effectiveness (Bundesanstalt fuer Strassenwesen, 2002). These guidelines specify designs of adequate effectiveness studies and indicators for approval of effectiveness. Thus, as meaningful criterion for effectiveness, traffic probation after successful completion of the course is defined. It is recommended to compare the treatment group to a matched control group of MPA-participants with positive assessment results. Recidivism rates of the treatment group should not significantly exceed recidivism rates of the control group. As some course providers may have difficulties to recruit adequate controls, the BASt established additional “Reference Values” for approval of effectiveness from earlier evaluation studies, indicating that recidivism rates of course participants should not exceed this Reference Values significantly. The following Reference Values for a look-back period of three years after licence reinstatement were set:

- Courses for the restoration of the fitness to drive for alcohol offenders: 18.8% (based on Winkler, Jacobshagen und Nickel, 1988; meaning that the amount of course participants registered with a subsequent alcohol offense should not significantly exceed 18.8%)

- Courses for the restoration of the fitness to drive for demerit point offenders: 32.6% (based on Jacobshagen & Utzelmann, 1998; meaning that the amount of course participants registered with repeated or serious offenses leading to 4 demerit points[1] should not significantly exceed 32.6%)

As no comparable evaluation studies for drug offender programs were available in 2002, no Reference Values for such courses were set at that time. However, the BASt already announced in the guidelines to adapt the Reference Values on the base of new empirical findings.

In 2009, the BASt started a new research project aiming at renewal of the Reference Values by collecting re-offense data of different offender groups. Additionally, the study also intended to initialize Reference Values for drug offender programs.

Methods

Data source

The Federal Motor Transport Authority (Kraftfahrt-Bundesamt, KBA) was contracted for data collection, because every final and legally binding decision about a road traffic offense in Germany is recorded in the Central Register of Traffic Offenders. This Central Register is kept by the KBA and contains notifications of the following institutions:

- driving licensing authorities (approx. 650 nationwide) which refuse, withdraw or newly grant driving licences,
- authorities imposing fines to punish traffic offences with a fine of at least 40 Euro or with a driving ban,
- courts which pass a sentence because of a punishable act committed in connection with road traffic. (Kraftfahrt-Bundesamt, 2013)

The data content of the Central Register of Traffic Offenders is reliable and valid and thus, served as pool for data collection of the study at hand.

Sample

Reason for licence revocation	**N (amount of offenders)**
Alcohol	44,228
Drugs	2,701
Reaching demerit point maximum threshold	1,560
Others[2]	18,902
Total	66,391

Table 1: Distribution of the sample by reasons for licence revocation

[1] 4 demerit points indicate either multiple minor offenses or one serious offense. Therefore, the 4-point-criterium is used as threshold of relevance for recidivism.

[2] The group of "others" consisted of offenders of whom the reason for revocation was not clearly identifiable or offenders with other offenses leading to licence revocation, e.g. dangerous driving, hit and run, etc.

The sample consisted of N=66,391 traffic offenders with licence reinstatement in 2006 after prior revocation. They were analysed regarding their traffic probation in the three years after licence reinstatement, whereby the exact three year period was considered based on the date of licence reinstatement. The offenders were assigned to an offender group (alcohol, drug, demerit point offenders and others (see footnote[2] above) based on the reason for prior revocation (see table 1).

Re-offense data analyses

Different indicators were used as criteria for re-offending:

- offense leading to a new in entry in the Central Register (P1)
- alcohol or drug offense leading to a new in entry in the Central Register (P1a)
- repeated offenses registered in the Central Register (PP)
- repeated offenses whereof at least one is an alcohol or drug offense (PPa)
- offense or multiple offenses leading to a minimum of 4 demerit points (P4, see footnote[1] above)
- offense or multiple offenses leading to a minimum of 4 demerit points whereof at least one is an alcohol or drug offense (P4a)
- repeated licence revocation (R)
- repeated licence revocation due to an alcohol or drug offense (Ra)
- culpable accident involvement (A)
- culpable alcohol- or drug-related accident involvement (Aa)

For each of the offender groups, frequency distributions regarding the different indicators were calculated.

Results

Averaged re-offense rates

On average, 38.4 % of the offenders were registered again with at least one offense (P1) in the Central register in the three year observation period. Almost every fifth offender (19.2%) reached the threshold of 4 demerit points (P4). Repeated licence revocation (R) was recorded for 7.6% and 4.7% of the total sample were involved culpably in an accident (A) (see table 2).

Target group-specific re-offense rates

It becomes obvious that demerit point offenders seem to pose the highest risk in traffic as 73.7% were registered again with at least one offense (P1) compared to only 34.4% of alcohol offenders and 39.9% of drug offenders. This is even supported by rates of culpable accident involvement (A): a double amount in the demerit point offender group caused an accident (8.8%), compared to only 4.1% in the alcohol group and 4.6% in the drug group. Surprisingly, demerit point offenders show the lowest rates of repeated licence revocation (R): only 4.7% were registered. In contrast, the amount of drug offenders with licence revocation in the observation period is almost doubled (9.3%; respectively, 6.5% in the alcohol offender group). Detailed re-offense frequencies for all offender groups are displayed in table 2.

Concerning the old-established Reference Values (Bundesanstalt fuer Strassenwesen, 2002), significant differences appear. Re-offense rates of alcohol offenders decreased considerably. Only 8% were registered with a new alcohol offense (P1a). In 6.5% of these cases, the licence was revoked again due to this offense (Ra). These amounts lie far below the Reference Value of 18.8% which was taken from Winkler, Jacobshagen & Nickel (1988). On the contrary, re-offense rates of demerit point offenders increased substantially. In the study at hand, 45.9 % of this offenders group reached the corresponding re-offense criterion of being newly registered with four demerit points (P4) compared to 32.6% in the study by Jacobshagen & Utzelmann (1998). Reference Values for drug offenders programs were not yet set in 2002, but results of the study at hand are in accordance with other evaluation studies of drug offender programs (DeVol, Hilger & Schupa, 2012; Biel & Birnbaum, 2004): for 9.6% of the drug offenders new drug offenses (P1a) were recorded within the three-year observation period.

Re-offense indicator	**Alcohol offender (N=43,228)**	**Drug offender (N=2,701)**	**Demerit point offender (N=1,560)**	**Others (N=18,902)**	**Total mean (N=66,391)**
P1	34.4	39.9	73.7	44.4	38.4
P1a	8.0	9.6	5.8	8.2	8.1
P4	16.4	19.1	45.9	23.5	19.2
P4a	8.0	9.5	5.8	8.1	8.0
PP	11.4	14.9	48.4	19.0	14.6
PPa	0.6	1.1	0.6	0.8	0.7
R	6.5	9.3	4.7	10.2	7.6
Ra	5.6	6.7	3.2	5.5	5.6
A	4.1	4.6	8.8	5.8	4.7
Aa	1.4	1.0	0.7	1.4	1.4

Table 2: Re-offense frequencies for different indicators per offender group (in %)

Discussion and conclusion

The results reveal significant differences between recent data and earlier studies of which the Reference Values had been taken. Hence, the Reference Values urgently need renewal based on recent data. However, differences in the data may have several reasons. For the alcohol offender group, the significant decrease from 18.8% to 8% may be due to the fact that the early study only considered repeated drink drivers. Repeated drink drivers belong to the group of hard core drinking drivers (Simpson, Beirness, Robertson et al., 2004) who by definition have a high risk of re-offending. The study at hand did not differ between first or repeat offenders. The sample contained both, also independent of further measures besides licence withdrawal (e.g. MPA or course participation), but it may be assumed that the majority were first offenders. Another reason for the decrease of re-offense rates may be an increase in deterrent effects due to enhanced enforcement and countermeasures for secondary prevention, i.e. assessment (MPA) prior to licence reinstatement, which have been established since the early study was carried out. For the group of demerit point offenders, the effect of enhanced enforcement may have worked the other way around: the increase of speed cameras and evolution of new techniques for the detection of traffic offenses has led to an increased risk of being caught. Thus, offenders have a higher likelihood of being registered with demerit points. Additionally, the catalogue of offenses which lead to demerit points has expanded in the meantime.

All in all, the collected data serve as a good base for renewal of the old-established Reference Values and may be applicable as comparative data for future evaluations. However, the data will be replicated with the aim of validation by a sample with licence reinstatement in 2007. Subsequently, the results are going to be discussed by experts and decision makers. The outcomes of these consultations will lead to the establishment of renewed Reference Values for the evaluation of future Section70-course programs.

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DRUID: Overview of the Project Results

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Abstract

Context
The 6th RFP project DRUID aimed at supporting European transport policy makers by suggesting scientifically based recommendations to combat impaired driving.

Objectives
The main DRUID objectives were:

- in-depth analysis of the problem situation with regard to DUI/DUID in Europe
- assessment of prevalence and accident risks of DUI/DUID on the basis of epidemiological and experimental studies
- evaluation of oral fluid screening devices and cost-benefit analysis of a strengthened drug-driving enforcement
- development of a classification system for medicines
- evaluation of driver rehabilitation schemes and strategies of licence revocation
- assessment of the effectiveness of new prescribing and dispensing guidelines for medicines
- development of policy recommendations on the basis of DRUID results

Key outcomes
- Alcohol is the most prevalent substance detected in drivers (3.5%), followed by drugs (1.9%) and medicines (1.4%)
- The first priority of countermeasures should always concern alcohol impaired driving
- The highest accident risk was associated with a BAC > 0.8 g/l and a combination of alcohol and drugs
- It is recommended to set a legal BAC limit of 0.5 g/l and an equivalent THC cut off (2 ng/ml)
- Drug recognition training of police officers should be improved
- Driver rehabilitation should be an integrated part of a comprehensive countermeasure system
- Immediate sanctioning and high levels of perceived risks of detection are crucial for deterrence
- A comprehensive information system for physicians and patients is an adequate countermeasure against driving while impaired by medicines

Discussion and conclusions
All in all, the DRUID results revealed that prevalence of psychoactive substance consumption, DUI/DUID, enforcement levels and legal strategies are very heterogeneous in European countries. Nonetheless, DRUID derives general recommendations as base for national solutions.

Introduction

In 2001, the amount of 50 000 fatalities on European roads prompted the European Commission to undertake a set of measures with the overall target of reducing the amount of fatalities by 50% until 2011. The Integrated DRUID Project (DRUID, Driving under the Influence of Drugs, Alcohol and Medicines) was launched in October 2006 within the 6th Research Framework Program. DRUID aimed at getting new insights into the risky impact of psychoactive substances on road safety and developing recommendations for road safety policy makers. The project filled the existing knowledge gaps and provided a solid base to generate harmonized, EU-wide regulations to combat driving under the influence of alcohol, drugs and medicine.

DRUID is the largest European research project in the domain of road safety in terms of geographic coverage (18 European countries; see Figure 1), budget (23.5 Mio. €) and number of partners (37 partners). It brought together the best European expertise in the area of road safety.

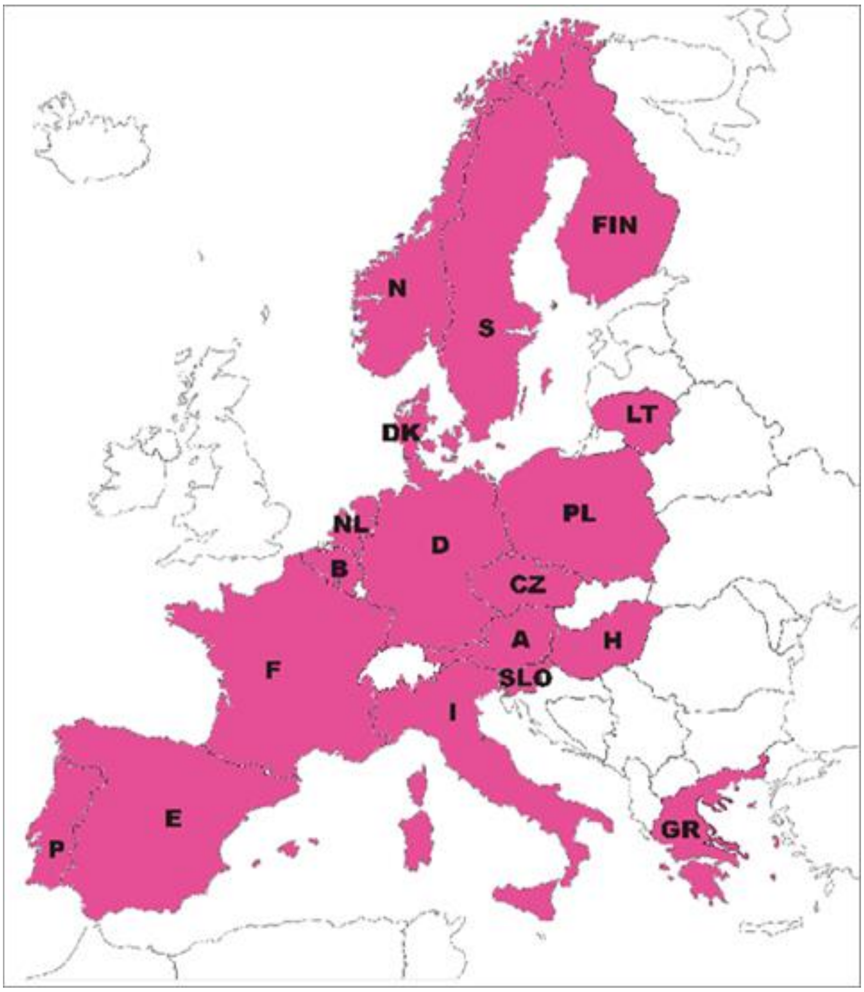

Figure 1: Geographical coverage of DRUID.

Key outcomes

Prevalence and accident risk of DUI/DUID

The prevalence of alcohol and drug use in the driving population was assessed in 13 European countries based on roadside surveys. Additionally, 6 countries conducted hospital studies to determine the prevalence of seriously injured drivers with and without substance consumption. Table 1 shows prevalence of DUI/DUID with accident involvement (cases) and without (controls).

		Substance group										
Country	Study	Negative	Alcohol	Amphetamines	Benzoylecgonine	Cocaine	Cannabis	Illicit opiates	Benzodiazepines + z-drugs	Medicinal opioids	Alcohol-drug(s)	Multiple drugs	In total
BE	cases	171	108	3	0	0	5	0	8	6	40	7	348
	controls	2597	220	0	4	2	15	3	62	23	12	11	2949
DK	cases	599	129	9	0	1	5	0	16	21	36	23	839
	controls	2858	81	1	0	0	7	0	22	26	5	2	3002
FI	cases	32	13	0	0	0	1	0	1	1	4	2	54
	controls	2627	21	1	1	0	2	0	32	16	2	4	2706
IT	cases	464	127	0	5	5	11	2	2	16	29	15	676
	controls	924	102	0	4	7	10	4	5	1	17	12	1086
LT	cases	282	60	1	1	1	1	0	6	22	8	3	385
	controls	1192	66	2	0	0	0	0	6	0	1	0	1267
NL	cases	125	48	2	3	0	1	0	1	1	7	0	188
	controls	4426	190	13	11	9	104	1	15	7	22	24	4822

Table 1: Number of cases and controls by country and substance group

The distribution of substance use in traffic is very heterogeneous in Europe, but it is obvious that alcohol is the most frequent psychoactive substance used in Europe. Besides, alcohol is often used in combination with illicit drugs (Tab. 1). In order to estimate the effect of psychoactive substance use on accident risk, the number of accident free drivers (controls) was compared with the number of serious injured drivers (cases). The calculated case-control ratio for each substance group is shown in Fig. 2 together with the prevalence of drug consumption and driving.

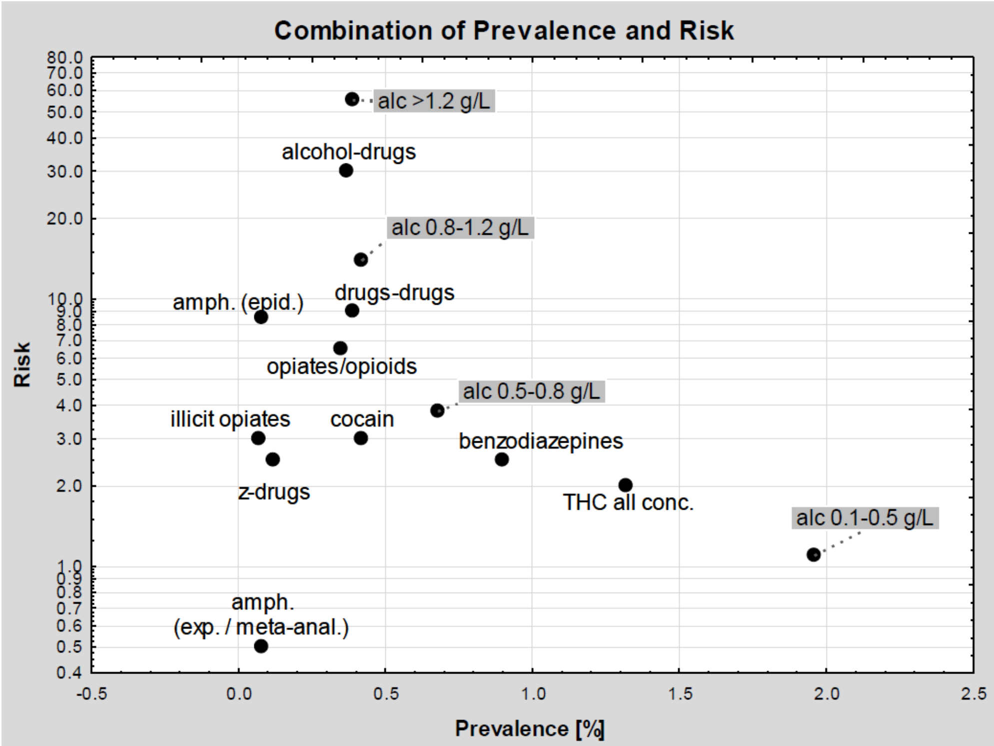

Figure 2: Illustration of prevalence and risk (logarithmic scaling) for the DRUID substance groups

Fig. 2 illustrates the highest accident risk for drivers with a blood alcohol level of more than 1.2 g/l alcohol, followed by drivers who consumed a mixture of alcohol and drugs. A rather moderate accident risk appears after the consumption of Cannabis (THC) which is the most frequently consumed drug asides alcohol. The data for amphetamines has to be handled with care as the number of amphetamine positive drives was too small (Tab.1) and experimental results showed different effects (Fig.2).

Drug-driving enforcement

Within DRUID, 13 oral fluid test devices were evaluated by police officers in cooperation with researchers. Only three devices were evaluated positively in combination with blood tests. The results of practical evaluations demonstrated that the quality and capacities of devices with regard to specificity and sensibility have not substantially improved after completion of ROSITA II (2005). The cost-benefit analysis of enforcement strategies resulted in a conclusion that increased drug driving enforcement by means of roadside saliva screening is potentially beneficial – especially for countries with low baseline enforcement level. However, the first priority of countermeasures should always concern alcohol impaired driving.

Classification system for medicines

DRUID managed to establish a broad consensus in Europe concerning the categorisation of medicines that affect fitness to drive. More than 600 substances were categorised. A four-level categorisation system and a three-level risk communication system are suggested. DRUID results are compatible with all existing national categorisation and labelling systems and may easily be integrated. DRUID results are compatible with currently available PC based reference systems for physicians and could be integrated in these instruments.

Prescribing and dispensing guidelines for medicines

The adequate countermeasure to combat impaired driving is information about possible side effects. These should include recommendations on how to act and decide in order to use medicines in a safe manner concerning road traffic. Therefore a comprehensive information system for physicians, pharmacists and patients about the potential impairing effects of medicines on fitness to drive, the maximum impairment and the duration of intake after which habituation takes place, should be implemented.

Driver rehabilitation schemes

The analysis of DUI/DUID rehabilitation procedures implemented in Europe shows that no uniformity exists regarding the practice and implementation of DUI/DUID rehabilitation. DRUID supports a preventive rehabilitation concept which is compatible with the overall objective of mobility of European citizens without endangering traffic safety. Driver rehabilitation should be an integrated part of a comprehensive countermeasure system against intoxicated driving. Driver rehabilitation should be offered target group-specific; i.e. drink-drivers and drug drivers should be treated separately. DRUID recommends developing European guidelines for legally regulated rehabilitation systems and procedures.

Strategies of driving licence related sanctions

The overview of licence revocation and suspension strategies embraced 27 EU Member States, Croatia, Norway and Switzerland. Results revealed that national strategies are very heterogeneous. Anyhow, punishment certainty is the main general deterrent factor. The secondary deterrent factor is the punishment celerity: the shorter the period between offence and the imposition of the sanction, the larger are the effects on recidivism. In case of substance dependence, a punitive sanction has no deterrent effect and does not lead to a behavioural change. A model of conditional licensing is only recommendable following a sanction of full revocation.

Conclusions

The EU-DRUID project conducted a comprehensive survey concerning all aspects of driving under influence of alcohol, drugs and medicines for the first time. The findings and derived recommendations form the basis for future transport policy decisions within the European Union and individual Member States.

Disclaimer: This report has been produced under the project DRUID of the EU 6th Framework Program and reflects only the authors' view. The European Commission is not liable for any use of the information contained therein.

Per se limits – recommendations for defining cut-off values for psychoactive substance use in traffic

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Abstract

Background
Legislative regulations and enforcement practices for combating driving under influence (DUI) of alcohol are clearly defined. Per se limits are based on blood levels of alcohol correlating with increased accident risk. Research for defining risk of DUI of other psychoactive substances (DUID) is still partly insufficient. In order to facilitate legal practices, laws against DUID are currently based on zero tolerance. In fact, drivers are considered being "impaired" if any amount of a listed drug is detected in their blood. Due to technical improvements the detection of small traces of substances is meanwhile possible since a long time after actual drug consumption, although impairment is no longer to be expected due to metabolism and elimination.

Aims
The DRUID expert consensus established recommendations on how to define limits for psychoactive substance use in traffic.

Methods
The European DRUID project established a group of experts who are members of national working groups for defining analytical and/or risk thresholds. This group evaluated the results of DRUID, scientific literature and the experience of representatives of several EU Member States and Norway in determining cut-off levels.

Results
- Cut-offs should be defined for the most frequently used psychoactive substances
- In order to achieve compliance of the population towards cut-off regulations, they should be clear and comprehensible, pointing out the risks when used in traffic
- Thus, the definition of cut-offs should be based on current scientific knowledge
- The lowest substance concentration exerting an effect on driving should be preferred instead of the lowest limit of quantification/ detection
- For all psychoactive substances including alcohol, the same risk should be accepted

Discussion
When a country intends to determine per se cut-off levels, several considerations have to be taken into account. From a scientific point of view, the same risk should be anticipated for all psychoactive substances including alcohol. Nevertheless, every cut-off discussion should address the question if the DRUID approach, to determine risk thresholds equivalent to alcohol limits, is feasible for the respective case.

Introduction

The general conclusions of the Pompidou Group stated that “The law enforcement and judicial authorities should have clear legislative and regulatory provisions, in line with which they can prosecute and convict individuals driving a vehicle whilst under the influence of psychoactive substances” (Pompidou Group , 2004, p. 379).

In case of combating DUI of alcohol, legislative regulations and enforcement practices are clearly defined. So far, per se limits for alcohol are based on scientific research evaluating potential risks associated to alcohol consumption. A clear correlation between alcohol consumption, blood concentrations and the score of driving impairment has been proven since several years. However, up to now, defining exact limits for combating DUID still comprises a lot of challenges.

In the following, the recommendations of the DRUID expert group for the definition of per se limits for psychoactive substances (DRUID Deliverable D 1.4.2, 2011) are outlined and the DRUID risk research results are presented to exemplify the determination of a THC cut-off.

Determination of psychoactive substance cut-offs

Which drugs have to be chosen?

The list of psychoactive substances to be included in per se legislation shall embrace the substances most frequently found in the driving population and/or in drivers involved in an accident. Regulations for illegal drugs should be applied to the misuse of medicinal drugs as well.

How to deal with legal prescribed medicines?

For many legally prescribed drugs, an effect on driving ability has been proven. A clear distinction must be made with respect to chronic use and intermittent or even single use. In experimental studies, dosage effects were only investigated and observed with single users or new users. The reason for enrolling naive users in these experimental studies is the clear correlation between intake dose, systemic exposure and impairment in driving ability. It is not reasonable to define cut-off values for patients in long-term treatment due to adaptive metabolic changes often observed after chronic use. In this case, higher doses are prescribed due to decreasing efficacy. In parallel, patient are more and more used to compensate side effects like dizziness, headache and other side effects. In conclusion, the correlation between dosage and impairment can be best examined at an intra-individual level. Hence, an individual impairment check is an objective way to determine dose- response correlation and potential risks associated to drug use.

For legally prescribed drugs, the interaction with alcohol is also an important factor. Alcohol interacts with many medicines in an unfavourable way and thereby increases impairment. Hence, a careful evaluation of potential drug-alcohol interaction and respective recommendations should be part of the physician’s consultation.

Should metabolites be included?

In most cases, per se legislation will be limited to the parent drugs and/or active metabolites. In this case, a clear correlation of dose intake, systemic exposure, and driving impairment needs to be the basis for determination of cut-offs. However, in some cases, it is necessary to take into account metabolites, e.g. when the parent drug is unstable and is metabolised very rapidly. The inclusion or exclusion of metabolites will depend on the choice of matrix, storage conditions and preservatives added in the sampling tubes. Further on, it may also be useful to detect metabolites, not because they are included in the per se legislation, but because they increase the level of certainty of the toxicological determination.

Which cut offs are applicable to be implemented in legal regulations?

So far three different classes of substance cut-offs have been established. To determine which cut-off level shall be applied when implementing into the legislation, the scientific rational should be clear.

- "Risk thresholds": Concentrations in blood that indicate impairment or a certain accident risk (e.g. 0.5 g/L BAC).
- "Lower effect limits": The lowest concentration with an effect on driving (e.g. 0.2 g/L BAC).
- "Limit of detection" (LOD) and "Limit of quantification" (LOQ): Concentration that guarantees a valid and reliable analytical result due to technical limitations of measurements.

At the moment European countries which implemented zero tolerance regulation use usually the LOQ as cut-off. However, it is difficult to achieve the compliance of the driving population to legal regulations if cut-offs are implemented that do not indicate the point where driving impairment starts. Especially if, substance intake was too long ago that it effects driving. Thus, for combating DUID, the implementation of "risk thresholds" and "lower effect limits" are adequate.

Which empirical data should be used for defining cut-offs?

Cut-off values for psychoactive substances can only be established by considering risk assessment based on empirical science. The most relevant information for the determination of cut-offs is the increased accident risk related to a quantified substance concentration in blood. Therefore, epidemiological studies have to be conducted, but representative studies comparing prevalence in accident-free and accident-involved populations are difficult and expensive. Especially for substances with low exposure rates in the population, a huge sample needs to be examined in order to get reliable estimations. Thus, for most of the substances, either legal or illegal, epidemiological data necessary for calculating risk indices are incomplete or even missing. This leads to substantial problems for the estimation of risks. In these cases experimental data should fill the knowledge gaps.

In general, the following top-down procedure for cut-off determination is recommended:

- use epidemiological data on the accident risk of different single substance concentrations. If this data is not sufficient,
- use experimental data. If this data is not sufficient,

- let national expert rounds determine cut-offs by using additional information (e.g. pharmacokinetic drug profiles, consumption behaviour). If this information is not sufficient,
- use the LOQ (the advantage is that new drugs may easily be implemented into the list of impairing substances).

For the comparison and integration of study outcomes, resulting from different methodologies (case-control or responsibility studies, experiments in simulator or on-road), a reference curve is helpful. As stated in the “Guidelines for Drugged Driving Research” (Walsh et al. 2008, p.1263), in DRUID, alcohol data delivered through these different study methodologies have been used as the gold standard (DRUID Deliverable D1.3.1, 2011).Thus, to determine risk thresholds for illicit drugs, DRUID partners intended to find a concentration in blood at which the accident risk or, in experimental studies, the impairment of driving or performing abilities are equivalent to that associated with 0.5g/L BAC. This approach starts from the premise that alcohol impaired driving is tolerated up to a BAC of 0.5g/L in most European countries. This accepted risk should be applied to define drug cut-offs as well. Hence, for the cut-off definition it is recommended:

- to use alcohol data as reference (Guidelines for Drugged Driving Research, recommendation B2)
- to use blood as specimen (Guidelines for Drugged Driving Research, recommendation B21)

How to deal with combined drug consumption?

The epidemiological studies performed by DRUID have shown that people often use more than one psychoactive substance and that the combination of alcohol and drugs, or the combination of more than one drug, increases the accident-risk exponentially. If one applies the cut-offs defined for a single drug to a combined use as well, one would anticipate an increased accident risk. In these cases of uncertainty, it is recommended to use the LOQ instead of the per se limits “risk threshold” or “lower limit of effect”.

Legal regulations

The cut-offs of psychoactive substances should go in line with the alcohol cut-offs and their legal regulations. The list of drugs in per se legislation can even be limited to a few substances, if per se law is combined with an impairment law that covers all other impairing substances. Moreover, with regard to new drugs, it might take some time before different cut-offs have been established.

Driving ability after acute drug effects

“Post acute effects” are impairing effects not caused by the drug itself, but caused by the symptoms of “hang over”. These will be excluded for the determination of cut-offs. This is similar with the procedure of determining the alcohol limit. If impairment would be measured the next morning after having consumed large quantities of alcohol, impaired performance could be detected below a BAC of 0.5 g/L. For alcohol, its presence in blood or breath is required for sanctioning. This may be the same for all illegal drugs, despite the fact that many substances afterwards cause deterioration as well (post-acute phase).

DRUID results for cut-off determination of THC

In the following these general recommendations for the establishment of cut offs will be used for the definition of a THC cut-off based on the DRUID results

In the DRUID project the relative risk for a driver being seriously injured in an accident due to substance use was calculated by comparing the number of accident free drivers (with and without substance use) with drivers being seriously injured (with and without substance use). The relative risk of a driver being killed in an accident was calculated in the same way. However, although more than 50.000 drivers participated, the prevalence of drivers' drug consumption was too small to calculate the accident risk for different drug concentrations other than alcohol. In case of THC consumption, independent of its concentration in the drivers' blood, the relative risk estimates, varied between countries to a high degree. However, based on data from all countries, the relative risk of getting seriously injured or being killed while positive for cannabis were not significantly above 1 with a risk of getting seriously injured of 1.38 (CI: 0.88-2.17) and the risk of being killed of 1.33 (CI: 0.48-3.67).

Only for the DRUID responsibility study which included 7.455 drivers, it was possible to split the results in three THC concentration levels. The highest "level" of a nearly 3-fold culpable accident involvement (OR: 2.84, CI 1.44-5.60) was found with a THC value between 3-5 ng/ml in whole blood. This goes in line with findings of other responsibility studies as well as with the literature findings for case control studies (DRUID Deliverable D2.1.3, 2011).

As no quantifiable relationship between THC concentration and accident risk was found in the epidemiological studies, it was only possible to set an exact THC cut-off by a meta-analysis of experimental studies. It was found that the serum concentration of 3.8ng/mL THC (≈2ng/mL in whole blood) causes the same impairment as 0.5mg/mL alcohol. For this risk threshold, a measurement error was calculated and added. The meta-analysis may also be used to define limits comparable to lower or higher BAC levels.

Conclusion and Discussion

Any cut-off discussion should address the question if the DRUID approach to determine risk threshold equivalent to 0.5g/L alcohol is feasible. From a scientific point of view, it can only be justified to accept the same risk for all psychoactive substances including alcohol. From a political point of view the determination of risk thresholds equivalent to 0.5g/L alcohol might be questionable, because a BAC of 0.5g/L is not a legal limit in all European countries. Some Member States have lower alcohol limits and therefore, risk threshold calculations for THC would have to be adapted accordingly. Further on, to determine a risk threshold equivalent to a determined BAC from experimental studies, it has to be assured that the study parameters are sensitive for the specific substance effects. This affects the definition of stimulant cut-offs. Epidemiological data are too rare to deliver concentration based risk results and up to now the experimental settings are not applicable for testing impairing stimulant effects. As long as no sensible parameters to measure a stimulant effect are established, a pragmatic approach to define cut-offs should be chosen. That means in general, if not enough scientific studies – whether epidemiological nor experimental - are available, pharmacokinetic data and the knowledge about the consumption behaviour and habits should support the determination of cut-offs.

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Medicinal drug use and driving

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Abstract

Introduction

In recent years, there has been increasing evidence pointing to a relationship between medicinal drug use and crash culpability. In particular, benzodiazepines and opioid analgesic are implicated in a considerable proportion of road crashes in Australia. There is also mounting concern about the potentially devastating effects of medicinal drug use in combination with an otherwise low-risk level of alcohol consumption.

Methods

13 healthy volunteers were recruited to this randomised double-blind placebo-controlled crossover study. Participants attended 8 sessions each in which they were administered three study drugs in unique combinations: (1) intravenous alcohol (target BAC=0.05g/100ml); (2) oral oxazepam 30mg; and (3) oral codeine 60mg. Driving ability was measured on a STISIM driving simulator before and after drug administration.

Results

Mixed-model analysis with repeated effects revealed significant impairment of driving on parameters such as standard deviation of the mean lateral lane position (SDLP, car-weaving tendency) and time-to-collision (TTC, speed/distance perception) after drug administration compared to placebo (no drug). Moreover, the deleterious effects were more pronounced in the poly-drug conditions.

Discussion

Acute therapeutic doses of oxazepam, alone and in combination with a social dose of alcohol, significantly impaired performance on a number of salient driving tasks and driving-related skills. As such, poly-medicinal drug use, even in the absence of alcohol, has the potential to cause deleterious effects on driver performance. These findings highlight the need for strategic educational campaigns regarding the risks of driving whilst taking prescribed medicines.

Introduction

Alcohol and drugs are implicated in approximately 20% of Australian driver fatalities (Drummer et al., 2004). The role of prescription medications, most notably benzodiazepines and opioid analgesics, in both fatal (11.2% and 9.3% respectively) and injurious (14% and 3.4% respectively) crashes is becoming increasingly apparent (Drummer et al., 2003; Griggs et al., 2007). An investigation into driver fatalities in Victoria, NSW and Western Australia between 1991 and 1999 revealed that in 9.3% of cases, the driver tested positive to both drugs and alcohol (Drummer et al., 2003). Although opioids and benzodiazepines were present in approximately 4% of all drivers that tested positive for drugs other than alcohol (Drummer et al., 2003), neither drug alone showed a strong positive association with crash culpability (Drummer et al., 2004). However, when detected in combination with other psychotropic drugs and/or alcohol, a strong and significant association with culpability was apparent. The abundance of epidemiological data linking the presence of drugs, other than alcohol, with increased crash risk has led to new policy initiatives that provide for random roadside drug testing across most Australian states, and Standard Impairment Assessments with the potential to convict for driving under the influence of prescription drugs. However, despite evidence relating the use of opioids and benzodiazepines to driving offences, very limited experimental research exists to confirm the nature of any impairment (Drugs and Crime Prevention Committee, 2007).

Aim

This double-blind randomised placebo-controlled crossover trial was conducted to examine the effects of therapeutic doses of oxazepam and codeine, alone and in combination with a moderate dose of alcohol delivered by intravenous (IV) infusion (target blood alcohol concentration = 0.05%), on simulated driving performances using a high fidelity driving simulator.

Methods

13 healthy volunteers were recruited to this study. Each participant attended 8 experimental sessions of approximately 6 hours duration (1 hour preparation and 5 hours monitoring) in which they were required to complete a driving task on the STISIM Driving Simulator and associated questionnaires, and also provide blood samples both before and after drug administration. At each session, participants were blinded to the study condition: (i) intravenous ethanol or 5% dextrose, (ii) 30mg oral oxazepam or a matched placebo; and (iii) 60mg oral codeine or a matched placebo. Target blood alcohol concentrations were achieved and maintained via the oral/IV clamp method.

Table 1: Example schedule of drug administration.

	Alcohol (IV infusion)	***Codeine***	***Oxazepam***
Session 1	Placebo	Placebo	Placebo
Session 2	Placebo	60mg	Placebo
Session 3	Placebo	Placebo	30mg
Session 4	Ethanol (0.34g/kg)	Placebo	Placebo
Session 5	Ethanol (0.34g/kg)	60mg	Placebo
Session 6	Ethanol (0.34g/kg)	Placebo	30mg
Session 7	Placebo	60mg	30mg
Session 8	Ethanol (0.34g/kg)	60mg	30mg

Participants were familiarised with the driving simulator upon arriving at their first experimental session with an initial 5 min practice drive incorporating variations in road curvature, changes to speed limits and a road environment similar to that in the test condition. Following that, participants practiced on a second simulation drive, which include exposure to the relevant test tasks. The duration of the second practice drive was dependent upon the participants achieving a plateau effect in their responses (approximately 10 mins). Workload in the test drives was manipulated through the use of a conventional human factors method (a secondary task) built into the simulator and the inclusion of near-miss scenarios. The time-to-collision (TTC) task required participants to judge the time, distance and speed of oncoming traffic. Vehicular control was measured as the standard deviation from the participant's mean roadway position (SDLP).

Data were analysed using a mixed model design (full factorial) with repeated effects (experimental sessions 1-8; testing times 0, 2, 3 and 4 hours) and autoregressive covariance structure. A type 1 error rate of 0.05 was adopted.

Results

Data analysis revealed that TTC estimates were not sensitive to alcohol and codeine alone, but were sensitive to oxazepam. It was apparent that the presence of oxazepam, in any drug condition, resulted in a significant increase in accuracy of TTC estimates (less underestimation of time), translating to a decreased margin of safety and thus increased risk (Figure 1).

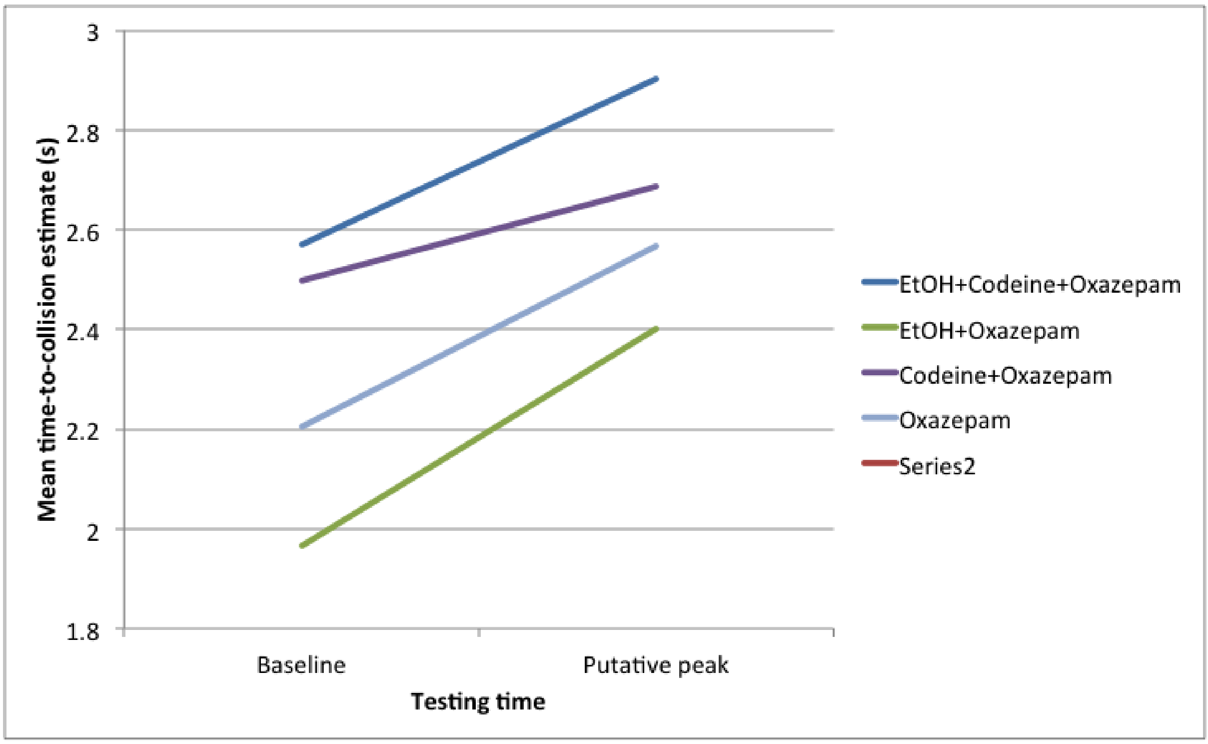

Figure 1: Mean TTC estimates from baseline (pre-drug administration) to putative peak testing time (3 h post drug administration) for all oxazepam conditions.

A similar relationship was observed with SDLP measurements. That is, SDLP was significantly ($p<0.005$) greater (i.e. greater swerving tendency) in all oxazepam conditions compared to the no-drug condition. No such impairment was observed in the alcohol alone, codeine alone or alcohol and codeine combined conditions (Figure 2).

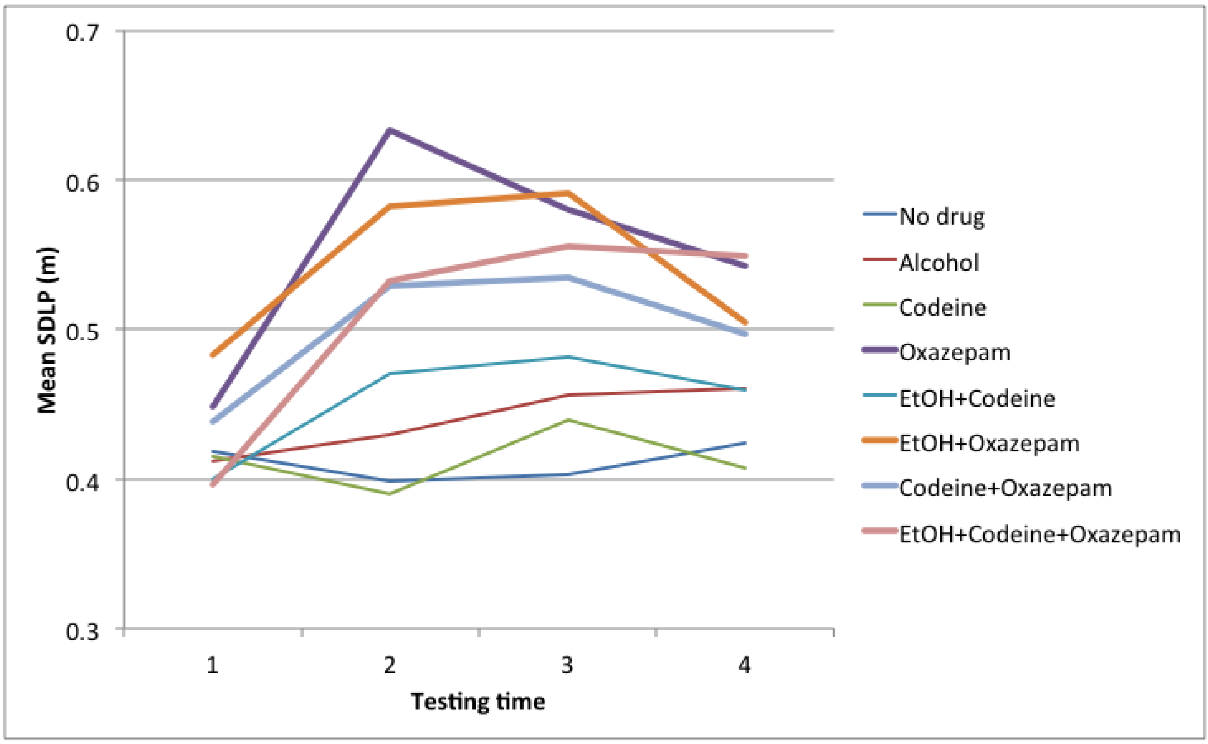

Figure 2: Mean SDLP at each testing time (i.e. before drug administration; and 2, 3 and 4 hours post drug administration) for all conditions.

Discussion

The results of this study demonstrate that oxazepam, in particular, significantly impairs a driver's ability to safely perceive gaps in traffic and also maintain vehicular control. This was observed even in the absence of any other drug. In contrast, a therapeutic dose of codeine and a moderate dose of alcohol (BAC = 0.05g/100ml) did not appear to influence driver performance, alone or in combination. Given these findings, and poor community understanding of the impact of medications upon driving performance (Mallick, Johnston, Goren, & Kennedy, 2007), there is a need for further research into the effects of therapeutic doses of common medicines on driver behaviour.

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The benzodiazepine hangover: Next-day residual effects on driving performance.

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Abstract

Context
Benzodiazepines (BZDs) are implicated in a considerable proportion of road crashes in Australia (behind only alcohol and cannabis respectively). In fact, BZD hypnotics are the pharmaceutical drug most commonly detected in driver fatalities and serious injuries in Australia. Based on epidemiological estimates, the road safety burden from BZDs is almost on par with the road safety burden relating to all illicit drugs combined.

Objectives
A review of reported patterns of BZD use, epidemiological studies of BZDs and crash risk, and laboratory studies of psychomotor and cognitive effects of BZDs was conducted.

Key Outcomes
BZD hypnotics provide clinically desirable effects (e.g. sedation and reduced alertness) at night for insomniacs. However, these same effects become adverse if experienced during the day. Ideally, a hypnotic should facilitate sleep at night (the typical time taken) but be free from residual sedative effects the following morning. Even relatively subtle residual effects may have serious consequences for daily activities and potentially devastating effects on road safety. Aside from the acute impairing effects of BZDs that may impair driving performance, there is a need to consider issues associated with longer-term use. BZDs are frequently used outside clinical guidelines (i.e. long-term), despite the absence of clinical evidence to inform this practice. It is now widely accepted that, even at normal therapeutic doses, BZDs have the ability to cause both physiological and pharmacological dependence. This is evidenced by the onset of withdrawal symptoms when the drugs are discontinued. Nevertheless, there is still considerable debate about whether BZDs effect any long-term impairment on sleep architecture and cognition.

Discussion and conclusions
This paper highlights gaps in the current knowledge relating to residual BZD effects on driving and cognitive performance with chronic use, and suggests approaches for future research to inform appropriate management of and advice relating to BZD use.

Introduction

Benzodiazepine (BDZ) hypnotics are primarily indicated to treat sleep-related disorders, a condition that is estimated to be prevalent in 10-40% of adults (Mai & Buysse, 2008). For sufferers of insomnia, the medications used to treat the condition, as well as the condition itself, have both been associated with compromised fitness-to-drive. In fact, BZDs are the prescription drug most commonly found in injured (~14%) and fatally-injured (~5%) drivers (Drummer et al., 2003; Griggs et al., 2007). They are also one of the most commonly prescribed psychoactive medicines in Australia, with script volumes remaining relatively constant over the last 10 years (Figure 1).

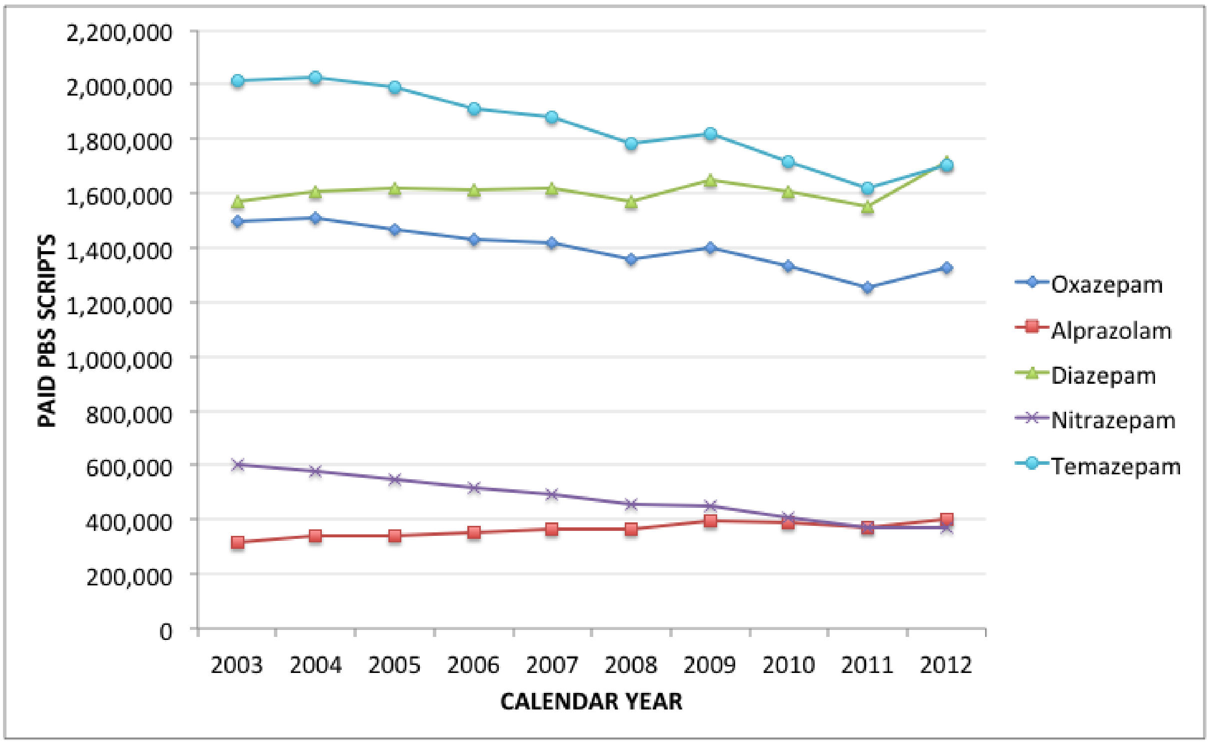

Figure 1: Pharmaceutical benefits scheme (PBS) script volumes for benzodiazepines from 2003 to 2012 (data sourced from Medicare Australia, 2013).

Residual impairment of driving performance after hypnotic BZD use

BZD hypnotics should facilitate sleep at night (the typical time when taken), with resolution of any sedative effects by the following morning. However, data from reported patterns of use, and epidemiological studies of crash risk and laboratory studies, together point to there being residual effects of the medication (Rapoport & Banina, 2007). This has implications for daytime functioning and alertness, and could result in impairment of cognitive and psychomotor skills, such as those required to safely drive a car. The strength of the residual effect is believed to be dependent on the type, dose, time since administration and frequency of dosing of the BZD, although this is not exclusively the case (Vermeeren, 2004). Hypnotics with short half-lives have also been shown to produce residual effects. As such, there is currently no clarity about which BZDs produce residual effects, how long these effects persist, and to what extent the effects influence cognitive functioning and driving skills.

Epidemiological studies have indicated that there is an increased risk of crash involvement the morning after administration of a BZD hypnotic, although the strength of this association remains unsubstantiated due to conflicting evidence (Rapoport et al., 2009; Smink, Egberts, Lusthof, Uges, & de Gier, 2010; Vermeeren, 2004). This is, in part, due to other consumer factors (such as age, comorbid medical or psychiatric disorders, other medications) rather than the BZDs themselves. As such, culpability is yet to be confirmed. A number of laboratory and driving simulator studies have demonstrated the potential for residual impairment of tracking ability, visual discrimination and reaction time, up to 11 hours after night-time administration of a BZD (Seppala, Korttila, Hakkinen, & Linnoila, 1976; Verster, Veldhuijzen, & Volkerts, 2004; Willumeit, Ott, & Neubert, 1984). This phenomenon has typically been more prominent with long-acting BZDs (Hindmarch & Subhan, 1983; Iudice et al., 2002), although exceptions have been reported. Flunitrazepam (2mg) and lorazepam (1mg) are two examples of intermediate-acting BZDs that have demonstrated residual effects on on-road car handling, up to 17 hours post-dose, in insomniacs and anxious patients respectively (Hindmarch & Gudgeon, 1980; Verster, Veldhuijzen, Patat, Olivier, & Volkerts, 2006). Lorazepam has also been shown to impair on-road driving performance (tracking ability) in both anxious patients and healthy volunteers treated with 2mg lorazepam twice daily for 7 days (Verster et al., 2004; Verster, Veldhuijzen, & Volkerts, 2005).

Long-term BZD use and cognitive impairment – A question of tolerance?

Estimates from the National Health Survey 2007-2008 revealed that over 200,000 Australians had used BZDs to treat a sleep disorder (i.e. BZD hypnotics) in the 2 weeks prior to being surveyed, with approximately 30% of those having used the medications on more than three occasions per week for six months or longer (Australian Bureau of Statistics, 2009). There are very few, if any, accepted medical indications for such long-term use. Despite this, BZDs are commonly used outside therapeutic guidelines (Mant & Walsh, 1997). A recent thesis by Hansen (2012) demonstrated a strong relationship between sedative prescriptions and risk of motor vehicle crash (hazard ratio = 2.23, n = 676,694), with the highest risk group being those who had 121-240 days of continuous prescription fills (Hansen, 2012). This long-term use has implications for the safe and effective conduct of complex daytime activities such as driving. However, to date, only two experimental driving studies have endeavoured to address the question of driving impairment after chronic BZD hypnotic use (>3 months for at least 4 nights per week) the morning after use, and these were done in a population comprised of older drivers (T.R.M Leufkens, Ramaekers, de Weerd, Riedel, & Vermeeren, 2011; Tim R. M. Leufkens, 2009). The placebo-controlled crossover study found significant residual impairment of zopiclone (7.5mg) on highway driving in unmedicated insomniacs, chronic users of hypnotics and normal sleepers, while the parallel design cohort study revealed no significant differences between highway driving performances of unmedicated insomniacs, chronic users of hypnotics and normal sleepers.

Directions for future experimental research

Despite the existence of epidemiological research relating the use of BZDs with an increased risk of road crashes (Orriols et al., 2011), limited experimental evidence exists to confirm a causative role, particularly when considering chronic use and/or residual effects. The research that does exist remains inconclusive. There are a number of key limitations that could account for the disparity in previous experimental findings. Namely, these studies either utilised only laboratory-based psychomotor tests (as opposed to on-road or driving simulator tests), or adopted an acute dosing regime (e.g. single dosing or repeated dosing up to a maximum of 17 days), and in most cases examined the phenomenon in healthy volunteers rather than a patient population (e.g. insomnia patients) (Rapoport et al., 2009; Vermeeren, 2004). Two studies by Leufkens and colleagues are the only exceptions. Both these on-road studies investigated the chronic and residual effects of benzodiazepine use in a patient population, compared to age-matched healthy controls and unmedicated insomniac controls. Only one found significant differences in driver performance, and that was after zopiclone administration. It should be noted, however, that the age range of the participants in both studies was 52 to 73 years, with the mean age of over 60 years in each experimental group. Age is of particular importance to both driving and cognitive performance, particularly when considering that cognitive degradation increases with increasing age and the proclivity of certain age groups to be involved in road crashes (age <25 and >65 being at highest risk). Although the prevalence of chronic benzodiazepine use does peak in the elderly, use/misuse remains considerable in the younger populations and has been shown to increase steadily in those aged in their mid-20s onwards (Hollingworth & Siskind, 2010). Despite this, there is continued neglect in the experimental literature of the effects of benzodiazepine use in younger age groups.

Conclusion

The evidence base regarding benzodiazepine-induced residual driving impairment is currently tenuous as described above, and hence clear guidelines in relation to driving while taking these medications have not been developed. Despite a number of epidemiological studies relating the use of benzodiazepine hypnotics with road crashes, limited experimental data exists to confirm a causative role. Indeed, the absence of a systematic assessment of the impairing effects in patients suffering from insomnia compared to a control sample, has recently been identified as a major gap in our understanding (Rapoport et al., 2009). As such, further high impact experimental research is required to quantify the impairing effects of BZDs on driving and cognitive task performances the next day following night-time use. The outcomes of such research will subsequently inform appropriate management of and advice relating to BZD use and the implications for safe driving.

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Effective measures to combat drink driving offences: an attitudinal model in Hong Kong

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Abstract

Background
In Hong Kong, legal limits on the concentration of alcohol permitted in drivers' blood, urine, and breath were first introduced in 1995. Later legislation empowered the police to conduct breath tests without the need for suspicion, in what is commonly known as a Random Breath Test (RBT). Although drink-driving accounts for a relatively small portion of traffic accidents, the average killed and serious injury (KSI) rate for drink-driving accidents is higher than that for overall traffic accidents. From time to time, there are calls for heavier punishments for drink-drivers, particularly those who cause severe injury and death, such as longer prison sentences and driving disqualification periods. However, no consensus has been reached on the actual effectiveness of severe punishments in combating drink-driving offences.

Aims
In this study, a self-administrated mail-back survey was conducted to evaluate drivers' perceptions of the current levels of punishment for drink-driving offences.

Methods
The survey collected the information on demographics, driving experience, drinking habit, as well as driver's record of traffic offenses and accidents. A Stated Preference (SP) game was established to measure the associations between drivers' propensity to drive after drinking and penalty levels.

Results
The results of a binary logistic regression model revealed that the presence of an RBT and increases in fines, driving-offence points (DOPs) and the periods of license suspension and imprisonment were positively correlated with an increase in deterrent effects against drink-driving. The confounding effects on the association by attribute, including driver gender, income, and previous involvement in drink-driving offences, were deterministic.

Introduction

In 2009, the Hong Kong police were empowered to conduct Random Breath Tests (RBTs) at the roadside. Then, the three-tier penalty sliding scale legislation came into effect in December 2010 to combat successive drink-driving offences. Despite the remarkable reduction in alcohol-related

crashes, there are still calls for heavier penalties to deter drink driving, especially in cases of repeated convictions and high alcohol consumption. Nevertheless, empirical evidence on the effects of heavier drink-driving penalties on road safety performance is limited. Therefore, we attempted to measure the association between the type and level of penalties and their deterrent effect on drink-driving with the use of a well-designed attitudinal survey in this study.
In Hong Kong, monetary fines, demerit points, license suspensions, and imprisonment are the common penalties for convicted driving offences, including drink-driving. Since 1999, the prescribed legal limit for drivers' BAC in Hong Kong has been 50 mg/100 ml (0.05%), and any driver who commits a drink-driving offence is prosecuted. For the first conviction, the penalties include a deduction of 10 driving offence points (DOPs), a maximum fine of HKD25,000 (USD1 is approximately equivalent to HKD7.8), a minimum license suspension for six months, or imprisonment for three years. For a repeat conviction, the license suspension period is extended to two years (Transport Department, 2009). Thus, an attitudinal model to measure the relationship between driver demographics, driving experiences, and the deterrent effect of penalties, including fines, demerit points, license suspension, and imprisonment, is essential.

Method

Data collection
The attitudinal survey targeted all types of drivers holding a valid driving license on the roads in Hong Kong. The survey data were collected through a self-administered mail-back questionnaire. The questionnaire scripts were delivered at on-road parking areas that were evenly and widely distributed in all districts in Hong Kong around the clock during the period 2 March 2012 to 20 April 2012. A total of 2,586 questionnaire scripts were distributed, and 454 completed questionnaires were received (a response rate of 17.6%). Of the 454 respondents, 303 (66.7%) declared that they were casual drinkers, and 151 (33.2%) respondents declared that they did not drink at the time of being interviewed.

The questionnaire consisted of four parts: (i) basic information about the driver; (ii) trip characteristics at the time of answering the questionnaire; (iii) traffic offence information; and (iv) the driver's views on different penalties for drink-driving offences. The first part collected information on driver gender, age, education, personal income, and driving experience. The second part collected information on the attributes at the moment when the questionnaire script was given to the driver, including day of the week, time of day, geographical area, and vehicle type. The third part collected information on the driver's involvement in traffic offences, traffic accidents, and RBTs in the previous 12 months.

In the last part of the questionnaire, the driver's attitude toward existing penalties against drink-driving offences upon first conviction (i.e., a deduction of 10 DOPs, a maximum fine of HKD25000, maximum imprisonment for three years, and a minimum driving disqualification period of six months) were solicited. A five-point scale was used where 5 indicated "too high" and 1 indicated "too low." Subsequently, the casual drinkers only were exposed to six stated preference (SP) games, in each of which the driver was asked whether he or she would drink or not given a hypothetical combination of a monetary fine, DOPs, a disqualification period, an imprisonment period, and the presence of an RBT roadblock. With the use of an orthogonal fractional factorial experimental design, 18 combinations of monetary fines, DOPs, a disqualification period, an imprisonment period, and the presence of RBT were generated (Wang and Li, 2002, 2005). The 18 combinations of penalties were randomly assigned to three sets of questionnaire.

Statistical analysis

In determining drivers' perceptions toward the existing penalties for drink-driving offences, a mixed ANOVA was used to evaluate the difference in the perceptions of the casual and non-drinkers. A binary logistic regression model was applied to evaluate the association between driver propensity to drive after drinking and possible penalties. As every casual drinker was given six SP games, there were 1,818 records (303 casual drink drivers x 6) in the proposed model. Possible factors, including driver gender; age; education level; personal income; past involvement in drink-driving, other traffic offences, and traffic accidents; experience of RBTs; and penalty levels, contributing to the propensity to drink drive were identified.

Results

Driver perceptions of the appropriateness of drink-driving punishments

Table 1 presents the results of the ANOVA of the difference in the perceptions of casual and non-drinkers. As shown in Table 2, the casual drinkers and non-drinkers generally shared similar views on the suitability of existing penalties for drink-driving offences, except for the maximum duration of imprisonment ($F = 9.86$, $p < 0.01$, at a 95% confidence level). Generally, drivers considered that heavier penalties for drink-driving offences should be sought, as the ratings for all existing penalties, that is, a deduction of 10 DOPs (Mean =2.66, SD =0.93), a maximum fine of HKD25000 (Mean =2.58, SD=1.00), maximum imprisonment for three years (Mean =2.93, SD =1.07), and a minimum disqualification period of six months (Mean =2.35, SD =0.94), were all below 3. Casual drinkers considered the maximum imprisonment term of three years to be appropriate (Mean =3.04, SD =1.08), whereas non-drinkers considered a longer period of imprisonment (Mean =2.70, SD =1.04) suitable.

Table 1 ANOVA for perception of current penalties for drink-driving offences

Penalty	Deduction of 10 DOPs	Maximum fine of HKD 25,000	Maximum imprisonment for 3 years	Minimum disqualification period of 6 months
	Average score (Standard Deviation)			
Overall	2.66 (0.93)	2.58 (1.00)	2.93 (1.07)	2.35 (0.94)
Casual-drinkers	2.69 (0.91)	2.62 (1.02)	3.04 (1.08)	2.37 (0.97)
Non-drinkers	2.58 (0.97)	2.48 (0.94)	2.70 (1.04)	2.30 (0.88)
Absolute difference	0.11	0.14	0.34	0.07
Percentage difference	4.3%	5.6%	12.6%	3.0%
	ANOVA			
F-Statistic	1.47	1.89	9.86*	0.54

* Statistically significance at the 1% level.

Drivers' propensity to commit a drink-driving offence

Of the 303 casual drinkers, most (190, 62.7%) declared that they would not drink before driving no matter how heavy the penalties. Table 2 shows the results of the binary logistic regression model for the association between drink driving propensity and possible contributory factors.

Table 3 Binary Logistic Regression Model Results (n = 1,818)

Factor		Attributes	Coefficient	(*t*-statistic)	Odds ratio	95% C.I. Lower	Upper
(a)	*Drink driving enforcement*						
	- RBT	No	0.574	(4.128)**	1.775	1.352	2.330
		Yes	(Control)				
	- Fine (HKD / 1,000)		-0.022	(-2.701)**	0.978	0.962	0.994
	- Driving offence points (DOPs)		-0.043	(-2.508)*	0.958	0.926	0.991
	† Perceived equivalent fine		HKD1,926				
	- Duration of license suspension		-0.025	(-3.482)**	0.975	0.961	0.989
	† Perceived equivalent fine		HKD1,134				
	- Duration of imprisonment		-0.017	(-3.656)**	0.983	0.974	0.992
	† Perceived equivalent fine		HKD777				
(b)	*Confounding factors*						
	Gender	Female	0.804	(2.660)**	2.235	1.236	4.044
		Male	(Control)				
	Age	18-34	0.239	(0.417)	1.270	0.414	3.896
		35-44	-0.099	(-0.173)	0.906	0.297	2.761
		45-54	-0.176	(-0.311)	0.839	0.278	2.535
		55-64	-0.128	(-0.218)	0.880	0.278	2.780
		65 or above	(Control)				
	Education level	Primary	0.131	(0.473)	1.140	0.663	1.959
		Secondary	-0.066	(-0.344)	0.936	0.641	1.366
		Tertiary or above	(Control)				
	Personal income	Less than $10,000	-0.819	(-2.382)*	0.441	0.225	0.865
		$10,000-$14,999	-0.186	(-0.798)	0.830	0.526	1.311
		$15,000-$24,999	-0.191	(-0.896)	0.826	0.544	1.255
		$25,000 or above	(Control)				
	Offence	No	-0.262	(-1.843)	0.769	0.582	1.017
		Yes	(Control)				
	Accident	No	0.091	(0.478)	1.095	0.754	1.591
		Yes	(Control)				
	RBT Record	No	0.013	(0.083)	1.014	0.736	1.395
		Yes	(Control)				
	Drunk Driving	No	-0.929	(-4.972)**	0.395	0.274	0.570
		Yes	(Control)				
	Drug Driving	No	-0.168	(-1.154)	0.845	0.636	1.124
		Yes	(Control)				
	Constant		0.221	(0.349)	1.247		
	Number of observations		1,818				
	Unrestricted log likelihood		-775.867				
	Restricted log likelihood		-713.644				
	ρ^2 statistic		0.080				

*$p < 0.05$. **$p < 0.01$. CI: confidence interval.

†The model estimates fit well with the observed outcome at the 95% confidence level.

As shown in Table 3, the presence of an RBT (OR= 1.775, 0.95CIs =[1.352, 2.330]), and an increase in monetary fines (OR= 0.978, 0.95CIs =[0.962, 0.994]), license suspension period (OR= 0.975, 0.95CIs =[0.961, 0.989]), imprisonment period (OR= 0.983, 0.95CIs =[0.974, 0.992]), and DOPs (OR= 0.958, 0.95CIs =[0.926, 0.991]) all significantly reduced the propensity to drink before driving, at the 5% level.

The effects of driver demographics and involvement in traffic accidents and traffic offences on the propensity to drink-drive were marked. As also shown in Table 4, being male (OR = 2.235, 0. CIs = [1.236, 4.044]), a higher personal income (OR = 0.441, 0.95CIs = [0.225, 0.865]), and involvement in drink-driving in the past (OR = 0.395, 0.95CIs = [0.274, 0.570]) notably increased drivers' propensity to drink before driving, all at the 5% level.

Discussion

There is clear evidence to suggest that the joint force of appropriate enforcement measures and penalties is effective in deterring drink-driving offences (Ross and Klette, 1995; Glendon and Cernecca, 2003; Houston and Richardson, 2004; Tay, 2005a). An increase in monetary fines in particular is effective in deterring poor driving behavior (Wagenaar et al., 2007; Wong et al., 2008). Fines are considered to be a cost-efficient way of deterring drink driving. The positive correlation between a driver's propensity to drink before driving and the monetary fine in this study is consistent with previous findings. Likewise, an increase in DOPs is another important factor that contributes to an increase in the deterrent effect against drink-driving. The DOP system, which was first launched in Hong Kong in 1984, has been an effective means of improving driving behavior and enhancing road safety. The number of points incurred ranges from 3 to 10, depending on the severity of the offence. If a driver incurs 15 or more points within a period of two years, he or she is disqualified from driving for a period of at least three months. The license suspension period is extended to six months for a repeat conviction (Transport Department, 2009). The DOP system also leads to license suspension, and should thus also be effective in deterring drink-driving.

We found that the severity of punishment was notably correlated with the deterrent effect against drink-driving. Nevertheless, the deterrent effect of imprisonment was lower than that of the other penalties, as the perceived value for a unit increase (in one month) in the period of imprisonment was equivalent to a fine of HKD 777 only, whereas that for one DOP point and license suspension for one month was HKD1,926 and HKD 1,134, respectively. This is consistent with the finding of Nichols and Ross (1990) that the deterrent effect of license suspension is higher than that of other types of penalties. Wagenaar et al. (2007) also found that the deterrent effect of jail policies on drink-driving offenses in the United States was minimal.

Favorably, the presence of an RBT resulted in a noticeable reduction in drivers' intention to drink before driving. This is consistent with the finding of Ryeng (2012) that strengthened enforcement measures are effective in deterring drivers from committing traffic offences, whereas increases in penalty levels have only a marginal effect on driver behavior. The deterrent effects of an increase in the apprehension rate and the randomness of road-side breath tests are well documented (Tay, 2005b). A review by Porter (2011) indicated that the RBT can result in a 13-27% reduction in drink-driving related accidents. Another study by Erke et al. (2009) suggested that the implementation of an RBT can lead to at least a 17% reduction in alcohol-related accidents, based on crash statistics from Australia, New Zealand, the United States, and other countries.

The perception survey revealed that the drivers generally thought that the existing drink-driving penalties were somewhat too moderate. This supports the introduction of heavier penalties against drink-driving in Hong Kong. Nevertheless, severe penalties may not be an effective long-term anti-drink-driving strategy, and their introduction should be a last resort to reduce the propensity of drivers to commit drink-driving offences (Ross and Klette, 1995). It would be worth introducing other remedial measures to combat drink-driving first, such as zero tolerance and mandatory driving improvement courses. The authorities could further discourage alcohol consumption by increasing the tax on, and thus the retail price of, alcohol.

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Alcohol consumption and traffic and non-traffic accidents in Australia, 1924-2006

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Abstract

Background: There is a significant body of literature demonstrating that the rate of alcohol-related harm in a society is strongly correlated with per-capita alcohol consumption. In particular, studies have shown that mortality from a range of causes changes along with population level consumption. However, most of these studies have focussed on chronic outcomes such as liver cirrhosis, with few exploring whether accident-related mortality is affected by per-capita alcohol consumption.

Aims: This study aims to evaluate the relationship between changes in per capita alcohol consumption and traffic and non-traffic accident deaths in Australia from 1924 to 2006. We will also examine the impact of the introduction of random breath testing (RBT) on both types of accident mortality.

Methods: Gender and age specific traffic and non-traffic mortality rates (15 years and above) were analysed in relation to per capita alcohol consumption using Box-Jenkins techniques for time series analysis. The external effect of the introduction of RBT was measured by inserting a dummy variable in the time series models.

Results: Statistically significant associations between per capita alcohol consumption and both types of accident mortality were found in both males and females. The results suggest that an increase in per capita alcohol consumption of 1 litre was accompanied by an increase in accident mortality 3.4 among males and 0.5 among females per 100 000 inhabitants. A 1-litre increase in per capita alcohol consumption corresponded to an increase in non-traffic mortality about 3.0 among males and 0.9 among females. The association between alcohol consumption and traffic accidents was stronger among younger people than older people. However, the relationship between alcohol consumption and non-traffic accidents was weaker in younger people than older people. The estimated effects of the introduction of RBT show significantly reductions in traffic mortality in Australia, particularly for males and young people.

Discussion and conclusions: Changes in alcohol consumption have had substantial effect on both traffic and non-traffic accidents. Policies for controlling alcohol consumption would effectively help to reduce traffic and non-traffic accidents in Australia. Specific policies aimed at reducing drink-driving have demonstrably reduced traffic accident deaths.

Introduction

It is well-recognized that alcohol intoxication contributes to a large proportion of traffic and non-traffic accidents in many countries (Skog 2001a). Previous studies show that about 10% to 60% of all fatal traffic crashes appear to be alcohol related (Norström and Rossow 2013)

Furthermore, alcohol also plays a significant role in non-traffic accident, such as accidental falls and drowning, accident caused by fire, and other accidents (Rehm *et al.* 2010). Alcohol contributes to over 3000 deaths each year in Australia, and is implicated in, 50% of assaults, 30% of car accidents, 44% of fire injuries, 34% of falls and drowning and 12 % of suicides (NCETA 2004).

There is significant evidence that the level of alcohol consumption in a given society is related to the rate of alcohol-related problems (Norström and Ramstedt 2005). Studies examining whether accident mortality is related to population drinking levels are less common, but the existing evidence suggests a link, particularly in countries with intoxication-focussed drinking patterns. Two studies on data from Europe demonstrated significant associations between per-capita consumption and accident mortality, with the effect sizes varying across countries. On the whole, changes in population drinking affected accident mortality more in Northern Europe than Southern Europe, but the effect on traffic accident mortality was higher in the Southern European countries (Skog 2001a; 2001b). Other analyses have also shown a strong association between per-capita consumption and accident mortality in North America (e.g. (Skog 2003)), but there have been no Australian studies in this area.

The role of alcohol in accidents probably by varies in different gender, age groups and historical periods. Gender differences in the association between alcohol consumption and fatal accidents have been found in some previous studies, such as Skog (2003) and Ramstedt (2008), with effects on male mortality much higher than on female mortality. Similarly, previous studies have found varying effects across age group, with alcohol affecting traffic deaths among young people more than older people (Ramstedt 2008), while the effects on total accident mortality were smallest in the middle age group (30-49 years) compared with the young age group (15-29 years) and old age group (50-69 years) (Skog 2001b).

Random Breath Testing is a widely used drink-driving countermeasure in many countries and is particularly common in Australia (Rowland *et al.* 2012). RBT was introduced in Australia in 1976 and detailed analyses have demonstrated that its introduction significantly reduced alcohol-related crashes and fatalities (Henstridge *et al.* 1997; Peek-Asa 1999). The main aim of this study is to present the first estimates of the extent that changes in per capita alcohol consumption influence mortality rates of fatal traffic and non-traffic accidents in Australia. As part of this analysis we will explore the impact of WW2 and the introduction of RBT in Australia on accident deaths.

Methods

A proxy for per-capita alcohol consumption was constructed using data on the sale of alcohol sourced from the Australian Bureau of Statistics (ABS 2011). Early data were converted from gallons or proof gallons to litres of pure alcohol. This was then converted to litres of pure alcohol per resident aged 15 and older, with population data provided by the Australian Institute of Health and Welfare (AIHW) (AIHW 2008). Mortality data were provided by the AIHW on the basis of historical death certificate data. The AIHW have developed standardised historical mortality databases which track the relevant cause of death codes across the various classification schemes used in Australia. The death rates were age-standardised for men and women separately and ex-pressed per 100,000 population, using indirect standardisation to 2001 data from the Australian Census. Age-group specific mortality rates are unstandardized.

The one-off event dummy was constructed to represent the on-going impact of RBT on accidents in Australia. As RBT was first implemented in Australian in 1976, the RBT dummy variable is coded as 1 after 1975 and 0 between 1924 and 1975. This represents a simplification of the roll-out of RBT in Australia, which was introduced in different states at different times, but will provide a sufficient proxy for the purposes of this study. We also control for the effect of World War 2 on accident mortality, as mortality data during these years excluded service personnel and are thus artificially low for young males (as can be seen in the negative associations between WW2 and young male mortality presented below).

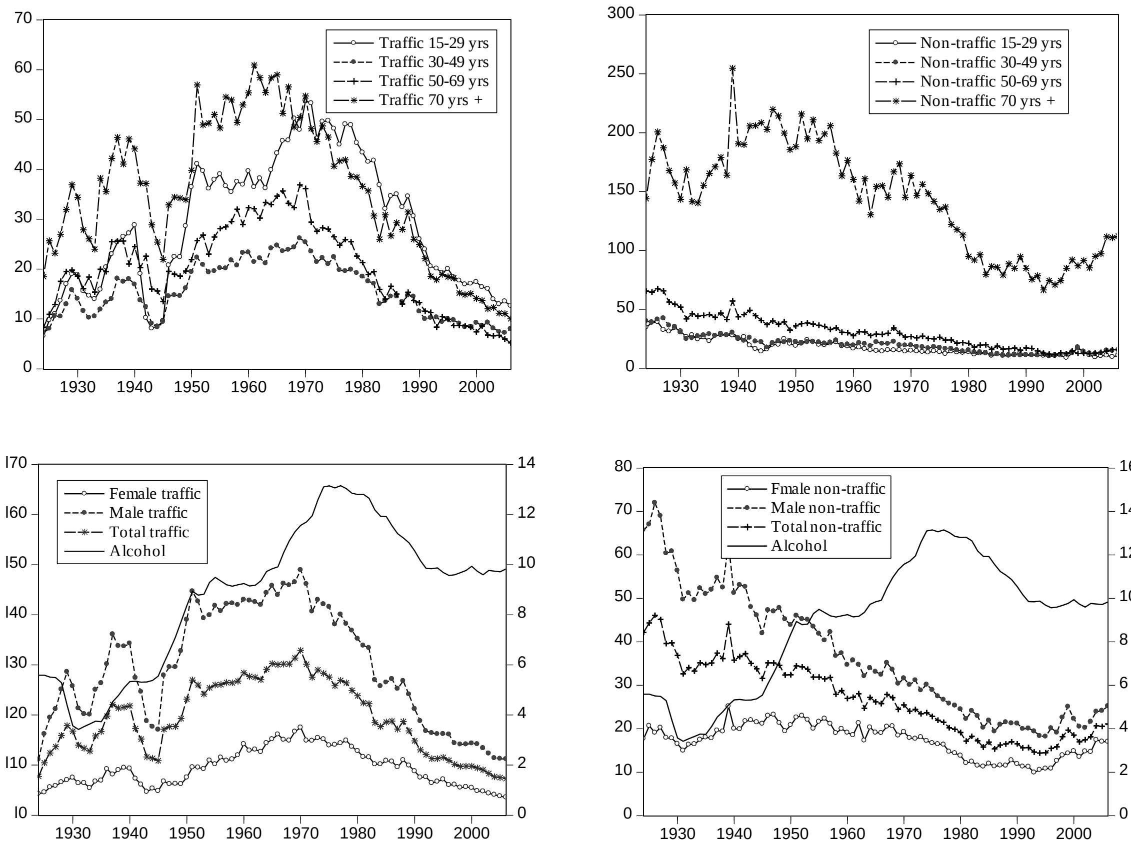

Figure 1 Trend in per capita alcohol consumption (15 years and older, refer to right axis) and, gender and age specific traffic and non-traffic accidents mortality rates (per 100 000 inhabitants) in Australia 1924-2006

Traffic and non-traffic accidents caused by intoxication will not be affected by historical alcohol consumption in the way that chronic mortality outcomes like cirrhosis are. Therefore, no lagged effects are considered in the current study. A autoregressive moving average model (ARIMA), known as Box-Jenkins (Box and Jenkins 1970) approach was employed to estimate the associations between alcohol consumption and, traffic and non-traffic accidents mortality in Australia. One-off event dummy variables were included in initial models to assess the impact of World War 2 and introduction of RBT in Australia since 1976 on the fatal traffic and non-traffic accidents. More elaboration about ARIMA models have been presented elsewhere (Skog (2001a), Livingston and Wilkinson (2013). As the trends in mortality rates were typically non-stationary (as shown in Figure 1), all models were conducted based on differenced data. The model fit was evaluated with the aid of the Box-

Ljung portmanteau test of the first 10 autocorrelations, $Q(10)$. The model structures used are reported below, alongside the output of the models.

Results

The results of the time series analyses between per capita alcohol consumption and traffic and non-traffic accidents mortality are reproduced in Table 1 for males, females and total mortality. The estimates in Table 1 suggest that an increase in 1-litre per capita alcohol consumption was associated with an increase in traffic mortality about 2 per 100 000 inhabitants. Increase in population drinking level would lead greater effect on male (3.4) traffic mortality than females (0.5). The results also suggest that a 1-litre increase in per capita alcohol consumption corresponded to an increase in non-traffic mortality about 3 among males and 0.9 among females per 100 000 inhabitants. The estimates of event dummies indicate that both World War 2 and the introduction of RBT since 1976 had generated significant negative effect on the traffic accidents mortality in Australia.

Table 1 Estimated effect of alcohol consumption on gender specific fatal traffic and non-traffic accident mortality

	Male		Female		Total	
	Coef.	SE	Coef.	SE	Coef.	SE
Traffic accidents						
Alcohol consumption	3.372**	1.027	0.534*	0.353	1.961**	0.622
WW 2 (1939-45)	-3.305**	1.012	-0.869**	0.330	-2.103**	0.613
RBT since 1976	-1.171$^{(*)}$	0.642	-0.543**	0.197	-0.830*	0.389
Constant	0.551	0.407	0.239**	0.124	0.387	0.246
Q (lag 10)	7.644, p=0.664		7.915, p=0.442		11.515, p= 0.319	
Model specification	(0,1,0)		(0,1,3)		(0,1,0)	
Non-traffic accidents						
Alcohol consumption	3.010**	0.605	0.884*	0.421	1.962**	0.493
WW 2 (1939-45)	-0.572	0.539	0.351	0.378	-0.166	0.442
RBT since 1976	1.370	0.312	0.330	0.231	0.851	0.265
Constant	-1.167**	0.196	-0.227	0.145	-0.697**	0.166
Q (lag 10)	5.985, p=0.741		8.794, p=0.457		7.613, p=0.574	
Model specification	(0,1,1)		(0,1,1)		(0,1,1)	

*$p<0.05$, **$p<0.01$, $^{(*)}$ $p<0.10$. Q-tests for uncorrelated residuals do not suggest unsystematic variation $p<0.10$.

In contrast, the impacts of RBT and WW2 on non-traffic mortality were statistically insignificant. The estimated effect of aggregate alcohol consumption on male and female traffic and non-traffic accidents are greatly different (males are nearly four times higher than females). There are two possible explanations for this difference (Skog 2001a). First, due to the qualitative differences in drinking patterns, frequencies and drunken comportment, males could experience more accidents per litre of alcohol than females. Second, generally, males drink more than females on average. Hence, a 1-litre increase in per capita alcohol consumption typically implies a much greater increase in male alcohol consumption than in female consumption.

The results of time series analysis of fatal traffic and non-traffic accident mortality by age are presented in Table 2. The findings suggest that the effect of alcohol consumption on fatal traffic accident mortality is positive and statistically significant (p<0.05) only in young and middle age groups. A 1-litre increase in per capita alcohol consumption led to a rise in traffic accident mortality rates about 4 among 15-29 years and nearly 2 among 30-49 years per 100 000 inhabitants. Introduction of RBT negatively and significantly affected fatal traffic accidents in nearly all age groups (except the oldest), with particularly large effects for young males (Tables 1 and 2). The estimates for non-traffic accidents show a different pattern, with the highest impact in the older age groups. No significant impact of RBT was found on fatal non-traffic accidents.

Table 2 Estimated effect of alcohol consumption on age specific fatal traffic and non-traffic accident mortality

	15-29 years		30-49 years		50-69 years		70 years and plus	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Traffic accidents								
Alcohol consumption	4.340*	1.317	1.507*	0.629	0.971	0.844	2.229	1.541
WW 2 (1939-45)	-3.659**	1.319	-1.622**	0.620	-2.147**	0.744	-3.657**	1.367
RBT since 1976	-1.373*	0.846	-0.599*	0.393	-1.090*	0.474	-1.422	0.868
Constant	0.683(*)	0.538	0.296(*)	0.249	0.498(*)	0.298	0.608	0.545
Q (lag 10)	4.034, p=0.909		6.401, p=0.750		7.899, p=0.162		8.876, p=0.449	
Model specification	(0,1,1)		(0,1,0)		(0,1,1)		(0,1,1)	
Non-traffic accidents								
Alcohol consumption	1.796**	0.345	2.281**	0.533	2.937**	0.705	8.201(*)	4.233
WW 2 (1939-45)	-0.542**	0.189	-0.924(*)	0.478	-0.151	0.626	5.323	3.738
RBT since 1976	0.747	0.129	0.854	0.295	1.243	0.359	2.715	2.236
Constant	-0.631**	0.080	-0.668**	0.185	-1.235**	0.225	-2.682(*)	1.402
Q (lag 10)	10.462, p=0.234		7.304, p=606		13.985, p=0.123		11.582, p=0.238	
Model specification	(1,1,2)		(0,1,1)		(0,1,1)		(0,1,1)	

*p<0.05, **p<0.01, (*) p<0.10. Q-tests for uncorrelated residuals do not suggest unsystematic variation p<0.10.

Conclusions

This study has verified that changes in alcohol consumption have had substantial effects on both traffic and non-traffic accidents in Australia. The findings suggest that the strongest impact on fatal traffic accident mortality rates of a change in population-level alcohol consumption is in relation to male accidents, particularly for 15-29 year olds, with non-significant effects in the older age groups. In contrast, the strongest association between alcohol consumption and non-traffic mortality was found in the oldest age groups. This reflects the underlying cause of death distribution, with older Australian more likely to die in non-traffic accidents and younger Australians in traffic accidents.

As expected, the impact of the introduction of RBT on the traffic accidents was negative and significant in Australia for both males and females, with particularly large impacts on young drivers. It is worth noting that the effect sizes for RBT produced here are likely to be underestimates, as they estimate the impact of RBT on traffic mortality over and above its impact via changes in total consumption. The findings of this research also suggest that reducing population drinking levels can lead a reduction in traffic and non-traffic accidents mortality rates. It highlights the importance of policies aimed at reducing the total amount of alcohol consumed to reduce alcohol-related harm. Policies that reduce total consumption (e.g. liquor licensing controls and alcohol taxation) are likely to produce reductions in accident mortality. These policies can be complemented by specific approaches designed to reduce accident mortality (e.g. RBT) which, as we have shown here, produce additional reductions in alcohol-related harm.

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Case Studies of Driver Intoxication Attributed to use of Synthetic Cannabinoid Designer Drugs

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Abstract

Background
Synthetic cannabinoid drugs with effects similar to marijuana have become popular since their appearance in Europe and the United States in 2009, and have been implicated in driver impairment.

Aims
The aim of the project was to identify characteristic behaviours, signs and symptoms in drivers subsequently confirmed as having ingested synthetic cannabinoid drugs as the sole apparent intoxicant consumed.

Methods
Blood samples from the individuals suspected of synthetic cannabinoid use were analysed for a relevant scope of synthetic cannabinoid drugs known to be prevalent on the street at that time. Arrest and laboratory reports from the subjects were reviewed and analyzed.

Results
Driving behaviours in these impaired drivers included poor vehicle control, collisions, and aggressive driving. Generally the constellation of effects was similar to those of marijuana, including watery bloodshot eyes, slightly dilated pupil size, lack of convergence of gaze, and increased pulse. There was no consistent evidence of horizontal or vertical nystagmus. Performance on field sobriety tests was poor, with problems with balance, coordination, fine motor control, attention, ability to follow instructions and presence of muscle tremors. The drugs detected in blood included JWH-018, JWH-250, AM-2201 and XLR-11. Concentrations of the drugs in whole blood were in the range 0.38 to 9.9ng/mL.

Discussion and Conclusions
The constellation of symptoms from synthetic cannabinoid use is very similar to that associated with marijuana use, with more frequent reports of anxiety. The clinical indicators were similar to those of the cannabis category in the Drug Recognition Expert (DRE) program. Synthetic cannabinoid testing should be performed in cases where the symptoms or history suggest cannabis use, but initial drug tests are negative. Future work will involve expansion of the scope of this testing and identifying additional cases with driving histories.

Introduction

Synthetic cannabinoid drugs have seen increasing popularity in the United States and worldwide since 2009 (Logan et al, 2011). These drugs which are prepared by spraying the psychoactive chemicals onto inert plant materials, and subsequently smoked in a joint or in a vaporizer, cause effects very similar to those experienced with marijuana. Forensic toxicologists face the challenge of relating observed symptoms of impairment documented during a DUI arrest with the subsequent toxicology test results. To date no published reports have appeared of the specific signs and symptoms observed in these drivers, against which to evaluate future cases. Additionally since the drugs are novel, no controlled administration studies have been performed on which to base these opinions. Post hoc evaluation of known impaired drivers provides the best set of data for evaluating this novel and poorly understood new class of drugs.

Methods

A series of cases of suspected impaired driving were reviewed in which the driver underwent a psychophysical assessment and subsequently tested positive for synthetic cannabinoid drugs, but negative for other impairing drugs or alcohol. Subsequent to their arrest the drivers were evaluated through the standardized Drug Recognition Expert (DRE) protocol, which includes collection of cognitive and psychomotor (balance, tremor, divided attention, muscle tone) and physiological indicators (pule, blood pressure, pupil diameter, lack of convergence, etc.) for evidence of common drug induced indicia.

Blood samples were subjected to routine testing by immunological and gas chromatographic procedures for the identification of drugs known to be common in the impaired driving population. In addition, based on the subjects' statements, drug material or paraphernalia found in the vehicle, or impairment unexplained by the results of routine drug testing, blood samples from the subjects were also tested for synthetic cannabinoid drugs. Initially samples were either screened by ELISA for species cross-reacting to a JWH-018, and JWH-250 ELISA (Arntson et al, 2013), or by liquid chromatography- mass spectrometry (LC-MS/MS) (modified from Kacinko et al, 2010). The scope of testing included AM-2201, AM-694 , JWH-018, JWH-019 , JWH-073 , JWH-081 , JWH-122 , JWH-175 , JWH-200 , JWH-210 , JWH-250 , RCS-4 and RCS-8.

Results

In total twelve cases were considered in which at least one synthetic cannabinoid drug was detected, but in which other drugs and alcohol were ruled out. Twelve subjects were positive for at least one synthetic cannabinoid, most were positive for more than one. Specific driving behaviours leading to the arrest were not available, although it was known that four of the cases resulted from motor vehicle accidents.

Review of the behaviour and appearance of the drivers indicated as follows. The attitude of the drivers was typically cooperative and relaxed, and coordination was noted to be generally poor. Speech was slow and slurred. Eye examinations indicated that eyelids were typically droopy, and their eyes were reddened. Subjects frequently had an inability cross their eyes (lack of convergence). Horizontal gaze nystagmus was typically absent in the subjects, while pupil sizes ranged from pinpoint to normal to dilated, with no apparent pattern.

Pulse rate was generally elevated, and systolic blood pressure was elevated in six of nine subjects in whom this was evaluated. In all cases, the DRE officer's final opinion was that the subject was under the influence of cannabis. This was unsurprising, since the DRE program does not have a separate drug category for synthetic cannabinoids and the symptoms noted above are all consistent with the appearance of a subject under the influence of marijuana.

Performance in field sobriety tests was generally poor, with subjects displaying eyelid and leg tremors, and body sway during the Romberg balance, one-leg stand and walk-and-turn tests.

Discussion

While the cannabinoid CB1 and CB2 receptor binding of various synthetic cannabinoids have been documented either in the open literature or in patents, very little has been published regarding their functional activity. Drugs that bind to receptors can be either full or partial agonists, antagonists or inverse agonists depending on the signaling they generate and the secondary messengers they release. Circumventing the in vitro - animal study – clinical trial model and releasing these drugs straight to the street market, means that very little is known about their effects or potency. The adverse effect profile of the drugs has to date prevented any controlled human administration studies, relying instead on more anecdotal reports. Research teams have reported some self-experimentation, and anecdotal observation of individuals who have recently smoked the drug do support the effect profile as being similar to that of marijuana, with an important difference of increased incidence of reporting of anxiety and paranoia. Seizures have also been reported.

Hermans-Clausen et al (2012) reported adverse events data on 29 subjects reporting to an emergency room, who later were confirmed via toxicology testing to have ingested synthetic cannabinoids including CP47,497, JWH-018, JWH-019, JWH-081, JWH-122, and JWH-122. These subjects also displayed effects similar to those described in marijuana smokers. Additionally reports of emergency department visits and calls to poison control centers have identified marijuana-like symptoms in these subjects. This series of arrested drivers also show symptoms consistent with marijuana use, including notable, bloodshot eyes, lack of convergence, increased pulse and blood pressure, and psychomotor effects on balance. The subjects did however show highly variable effects with some subjects performing well in field sobriety tests in spite of having elevated blood concentrations of the synthetic cannabinoids. Certainly in these cases other drugs and alcohol were ruled out as the cause of the observed impairment, making it likely that the reason these individuals came to the attention of the police was due to their synthetic drug use.

In the absence of structured dosing studies, short case series of actual impaired driving subjects with comprehensive toxicology testing to rule out other drugs, and a relevant scope of testing for the most current synthetic cannabinoids is a useful source of information about potential spectrum of effects that may contribute to impairment.

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Development of North American Consensus Guidelines for Toxicological Investigation of Impaired Driving and Traffic Fatalities Cases

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Abstract

Context
The purpose of the project was to identify best practices among laboratories performing drug impaired driving testing and to recommend a uniform set of guidelines to improve the quality of the laboratory data for both epidemiological and criminal justice purposes.

Objectives
The objective of the project was to develop a set of guidelines that laboratories could follow to ensure uniformity of practice, relevant testing parameters, and create comparable datasets for epidemiological study and forensically defensible toxicology results for use in criminal cases.

Key Outcomes
In November 2012, a set of recommendations were finalized based on consideration of analytical capabilities of most laboratories, toxicologically relevant concentrations, and prevalence data from the participating laboratories. Specific recommendations for the analytical approach were made based on the principle of an initial immunological screen of defined scope to include opiates, oxycodone, benzodiazepines (plus lorazepam, clonazepam), cannabinoids, amphetamine, methamphetamine, cocaine metabolite, methadone, carisoprodol, barbiturates, PCP, and zolpidem with quantitative confirmation by gas or liquid chromatography with mass spectrometry.

Discussion and Conclusions
The Panel also considered and established screening and confirmation thresholds for urine and oral fluid. Urine was generally seen as a less preferable sample, and while very few laboratories currently test for drugs in oral fluid, its value as a specimen in DUID casework was recognized. The laboratory recommendations will be published in early 2013.

Initiatives are in place to present these guidelines to stakeholder groups in traffic safety and public policy organizations to ensure resources are made available to laboratories to implement and observe the guidelines.

Introduction

The National Safety Council's Alcohol, Drugs and Impairment Division has a long history (as the Committee on Alcohol and Other Drugs, or CAOD) of promoting research policy and practice recommendations for blood and breath alcohol testing. This has included recommendations for duplicate breath testing, use of contemporaneous controls, and reporting practices. The Division has also issued some recommendations on the necessity of using confirmatory testing methods for forensic identification of drugs in biological fluids and tissues, and recently on the use of hair as a toxicological specimen for drug detection. In 2011, the Division initiated a project to collect data concerning the practices in laboratories performing drug testing for investigation of drug impaired driving cases, and motor vehicle fatalities. The purpose of the initiative was to update a set of recommendations for this testing, first published in 2007 (Farrell et al, 2007), taking account of changes in laboratory standards, practices and resources, and the changes in the illicit drug market. The complete results of the survey are published on the web site of the Center for Forensic Science Research and Education (Lowrie et al, 2013) and the methods, results summaries and recommendations described below are abstracted from that report, and other summary documents prepared for the National Safety Council, and the Transportation Research Board of the National Academies (TRB).

Methods

Toxicology laboratory directors or employees were contacted via email to initiate communication, confirm contact information, and verify their eligibility to participate in a survey regarding laboratory services in DUID cases. To create the survey, SurveyMonkey™, an online web survey instrument, was utilized. The survey questions focused on gathering information regarding current drugs being tested for, factors that affect drug collecting or analysis and ability to meet previous recommendations. The NSC CAOD committee expanded upon and amended the survey questions to increase their scope and clarity. The final revised survey was prepared for submission to confirmed participants via SurveyMonkey. The initial contact list included three hundred and seventy six toxicology laboratory directors or employees. These individuals were contacted via telephone and asked to participate in the survey if their laboratories conducted DUID/DRE casework. One hundred and twenty three individuals agreed to participate in the survey. These individuals were sent an initial contact email explaining the survey in more details and confirming their email addresses. Follow-up emails were sent to those who did not respond to the initial email. Telephone calls were also made to those who did not respond to the second email. Following these efforts, a total of ninety nine individuals confirmed their email addresses and their participation. The survey was then emailed to these individuals to complete. The survey responses were collected and analyzed. Follow-up emails were sent to participants who did not answer every question in an effort to obtain as much information as possible. As a disclaimer, in spite of efforts to collect data, some participants did not respond to all questions, therefore, the data represents ninety-six reasonably completed surveys to the point where the survey was rendered suitable to be included in the data analysis.

Results

A summary of the results of the project were presented to the Transportation Research Board of the National Academies, and described in their recent report (Logan, 2013) . The principal findings described included the following: the most frequently encountered drugs in impaired driver casework included marijuana, benzodiazepines, cocaine and amphetamines, opiates, muscle relaxants, and sleep aids. For screening purposes, the majority of laboratories reported meeting or exceeding the 2007 guideline recommendations for drugs of abuse, including carboxy-THC, benzoylecgonine, benzodiazepines, MDA, barbiturates, methadone, opiates and PCP, but not for amphetamines. The greatest degree of variability in whether recommended cut-offs were complied with was for therapeutic drugs including trazodone, nortriptyline, carisoprodol, zolpidem, topiramate and methadone, all of which can have significant impairing properties. Survey participants were asked about emerging recreational drugs showing up in casework beyond the scope of the 2007 recommendations, and those responses included the synthetic stimulants and hallucinogens mephedrone, methylone, benzylpiperazine, trifluromethylphenylpiperazine, dimethyltryptamine, and MDPV; the synthetic cannabinoids (JWH-073, JWH-250, JWH-081, JWH-122, JWH-210, JWH-019, JWH-200, AM-2201); and the therapeutic drugs modafinil, quetiapine, zopiclone, buprenorphine, and zaleplon, although with much lower frequency that the currently recommended drugs. The committee ultimately created a recommended scope and analytical cut-offs for a panel of 33 drugs (Table 1). Full details of the recommendations, including cut-offs for screening and confirmation in blood, urine and oral fluid are found in the committee's report (Logan et al, 2013).

Table 1. Priority Drugs for inclusion in testing for suspected DUID and motor vehicle fatalities.

Drug Class	Analytes including metabolites
Marijuana	THC
	Carboxy-THC
	11-Hydroxy-THC
CNS Stimulants	
	Methamphetamine
	Amphetamine
	MDMA
	MDA
	Cocaine
	Benzoylecgonine
	Cocaethylene
CNS Depressants	Alprazolam
	α-Hydroxyalprazolam
	Clonazepam
	7-Aminoclonazepam
	Diazepam
	Nordiazepam
	Lorazepam
	Oxazepam
	Temazepam
	Carisoprodol
	Meprobamate

	Zolpidem
	Butalbital
	Phenobarbital
Narcotic analgesics	
	Codeine
	6-Acetylmorphine
	Hydrocodone
	Hydromorphone
	Methadone
	Morphine
	Oxycodone
	Oxymorphone
Dissociative drugs	
	Phencyclidine

Discussion

This consultative approach was designed to build consensus and help to create a document that thought leaders and prominent laboratories in the United States would adopt to achieve the goal of more standardized testing in these important categories of investigations. In addition to the core drugs identified in table 1 as being prevalent and indispensable for a minimum scope, the committee also made recommendations about a second tier scope to include some of the more difficult to detect drugs, and newly emerging drugs whose capabilities may be beyond those of some state and local government laboratories. The expectation is that some better resourced laboratories will include some of these more esoteric tier 2 compounds in their scope of analysis to provide a rich data set for subsequent updates to the recommendations.

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Evaluation of the interlock programme for DUI offenders in Finland

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Abstract

Background
Finland started a trial with alcohol interlocks for DUI offenders in 2005. The positive experiences of the three-year trial led to an Act that allows the offenders to choose an interlock in their vehicle instead of facing a driving ban.

Aims
The aim of the evaluation study was to find out how the process of interlock-monitored driving rights is working and how effective it is in preventing DUI, as well as to get direct feedback from the drivers.

Methods
The study includes a questionnaire to all the drivers taking part in the permanent interlock program since July 2008 (N=1569), an analysis of the DUI offences of the drivers before, during and after the interlock period, an analysis of their interlock log data (read out every 60 days) and interviews with the relevant authorities within the process. The period of the evaluation study was July 2008 – June 2012.

Results
Alcohol interlocks used in the controlled driving rights have prevented at least 12 000 instances of driving while intoxicated since July 2008. The recidivism rate of interlock users is significantly smaller (5.7%) than that of all persons convicted of driving while intoxicated (around 30%), also after removing the device from the vehicle. 64% of the interlock driving licence holders told that the interlock affected the use of alcohol for them. Out of these drivers 19% had stopped drinking for good and 44% drink less nowadays, as the interlock has supported them in the process. 31% of the drivers told that they have kept or are going to keep the interlock in their vehicle even after having completed their mandatory period with it.

Discussion and conclusions
Despite the positive feedback and promising results on DUI prevention, several shortcomings were identified in the process of alcohol interlock-controlled driving rights in Finland. It is crucial to eliminate these shortcomings to make alcohol interlock use more common, with the positive effects on traffic safety it entails.

Introduction

In Finland during the years 2007–2011 yearly on average 79 people died and 900 were injured in road traffic accidents related to driving while intoxicated. These figures represent a quarter of all road traffic accident casualties and one tenth of all injuries sustained in road traffic accidents.

An alcohol interlock is a piece of equipment that measures the alcohol content of a driver's exhalation, and prevents starting of the vehicle if the permitted limit is exceeded. This study examined the effectiveness and impact of alcohol interlock-controlled driving rights. In

Finland, alcohol interlock-controlled driving rights were taken into permanent use on 1 July 2008, based on the positive experiences gained during a three-year trial.

A driver caught drinking under the influence of alcohol (≥ 0,5 ‰), may apply for an interlock driving licence from the police, instead of being imposed a driving ban. Before the interlock driving licence is issued, the driver needs to visit a doctor or another health care professional to discuss the intoxicant use, its effects on health and also the treatment possibilities for substance use.

The court decides the length of the interlock supervision period for each driver that applies for the interlock driving licence. The minimum length is one year, the maximum is three years. The obligation to drive a vehicle equipped with an interlock is marked with national code 111 on the driving licence.

In addition to the initial breath sample to start the vehicle, the device asks for random re-tests throughout the drive. The driver has up until 6 minutes to give the breath sample for a re-test. Furthermore, the driver needs to take the interlock to a read-out of the log data every 60 days. The licence administration of the police follows up the data.

Materials

Surveys

All the holders of an interlock driving licence (N=1569) were sent a survey by mail. E-mail surveys were sent to a few police departments and district courts and also to all interlock importers. Additionally one physician specialized in treating so-called problem drinkers was interviewed.

Log data analysis

The interlock log data was analysed out of one interlock model, which has about 86% share of the market in Finland. As there is no common register for the log data yet, the form of the data that is stored of the three interlock models is not uniform. That is why this study, with limited resources for data handling, included only the most common interlock model for log data analysis.

Violations data

All the DUI violations of the interlock driving licence holders were analysed before, during and after their use of the interlock. The violations data was extracted from the Driving Licence Register under the Finnish Traffic Information System.

The population

The average age of the interlock driving licence holders was 51 years. The youngest driver was 20 years old, the oldest 82. 84% of the drivers were male. One third of the drivers were workers on their employment status.

24 of these drivers had died since they were issued an interlock driving licence. Alcohol-related causes of death (37.5%) and suicides (16.7%) were much more prevalent among persons with interlock driving licence than in the general population (alcohol-related causes 3.7% and suicides 1.8%).

The survey for interlock driving licence holders

The response rate on the survey was 45.5% (685) of the Finnish-speaking drivers and 29.3% (19) of the Swedish-speaking drivers (total 704 drivers).

Persons convicted of driving while intoxicated perceived the alcohol interlock in varying ways. At one end of the spectrum, the alcohol interlock was viewed as a problem, a nuisance in everyday life and a shameful reminder of driving while intoxicated. At the other extreme, the alcohol interlock was considered a helper, an aid in life management and a safe travel companion, which prevented further mishaps. A tenth of all drivers concealed the existence of the alcohol interlock from everyone but their own family, and a few drivers even concealed it from their families.

Effects on alcohol consumption
However, the answers from the interlock users showed promising results on alcohol consumption. The majority of respondents (64%) said that the alcohol interlock had affected their alcohol use. Most drivers stated that they had reduced drinking. The respondents drank less or less often, or switched stronger drinks for milder. Several drivers said that the alcohol interlock had made them stop drinking before driving.

One-tenth of the respondents explained they had stopped drinking altogether, and that the alcohol interlock had motivated them in this decision. The alcohol interlock process also had a therapeutic, helping effect on some drivers, as they received professional and peer support.

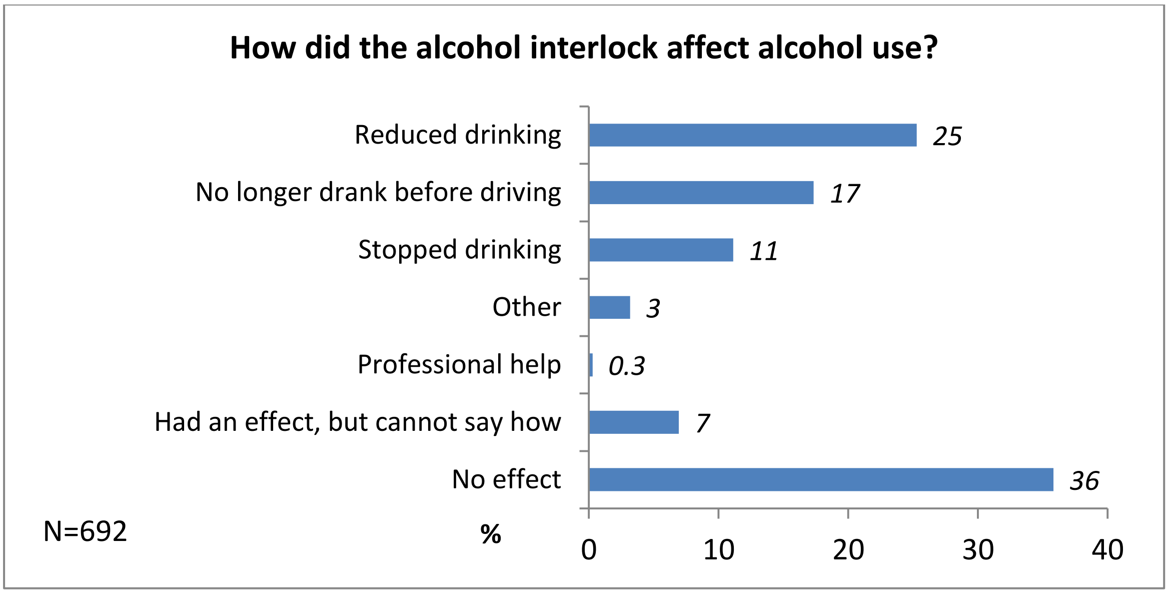

Figure 1. Answers on question "How did the alcohol interlock affect alcohol use?"

One third (31%) of the drivers told that they have kept or are going to keep the interlock in their vehicle even after having completed their mandatory period with it. Out of all the respondents 63% stated that interlock is very necessary and 25% that it is quite necessary for all DUI offenders.

Best things about using an interlock
The interlock users were also asked to share the best and worst things about using an interlock. Keeping one's driving rights was felt to be the largest benefit of alcohol interlock-controlled driving rights (95% of all the respondents). As it was possible to choose several

options, more than half (58%) of the drivers also appreciated the certainty that they would not accidentally set out intoxicated. One-third of the drivers kept their jobs thanks to the alcohol interlock. The emphasis on traffic safety was also valued (28%).

Free-form answers listed getting sober as a benefit of the alcohol interlock, as well as the fact that the interlock "teaches one to think" and reminds of "the dangers of the drink". Some drivers viewed the alcohol interlock as a friend and travel companion: "I drive a Renault and I've named the alcohol interlock Pierre. Pierre tells me when it's safe to drive. Above all, the alcohol interlock is a health instrument and a friend."

Worst things about using an interlock
The drivers perceived waiting for the device to warm up (59% of all the respondents) and the expenses (57%) as the worst aspects of using an alcohol interlock. Almost half (54%) of the respondents considered exhaling while driving to be unpleasant, and many felt it to be a safety hazard, especially in a tight spot. The interval of re-exhalations was felt to be too frequent and, conversely, the restart interval too short. Exhaling in public was felt to be awkward by 43% of the respondents. Many also described the attitude of outsiders as suspicious or negative.

Recidivism

More than half of the drivers had been convicted of driving while intoxicated several times before applying for an alcohol interlock-controlled right to drive.

Of all the drivers, 3.3% were caught driving while intoxicated during their period of alcohol interlock-controlled driving rights (most likely with another vehicle, not fitted with an interlock). After the end of the interlock supervision period, 2.5% of the drivers were caught driving while intoxicated.

Thus, a total of 5.7% of the drivers were caught driving while intoxicated during and/or after their period of alcohol interlock-controlled driving rights. The recidivism rate of alcohol interlock users seems to be significantly smaller than that of all persons convicted of driving while intoxicated. Generally the recidivism rate in Finland is around 30%.

Log data

The interlock log data was analysed out of 1505 interlocks used by the DUI offenders. Based on the log data, interlocks used in controlled driving rights have prevented at least 12 000 instances of driving while intoxicated (≥ 0.5 ‰) since July 2008 in Finland. Overall the interlocks have prevented over 40 000 times a driver who had "had a few" (≥ 0.2 ‰) to start a vehicle for driving (the number includes also the cases with ≥ 0.5 ‰).

Most of the rejected initial exhalations did happen on Monday mornings. However, all the mornings were well represented, as well as the afternoons (12–18 o'clock) on Saturdays and Sundays.

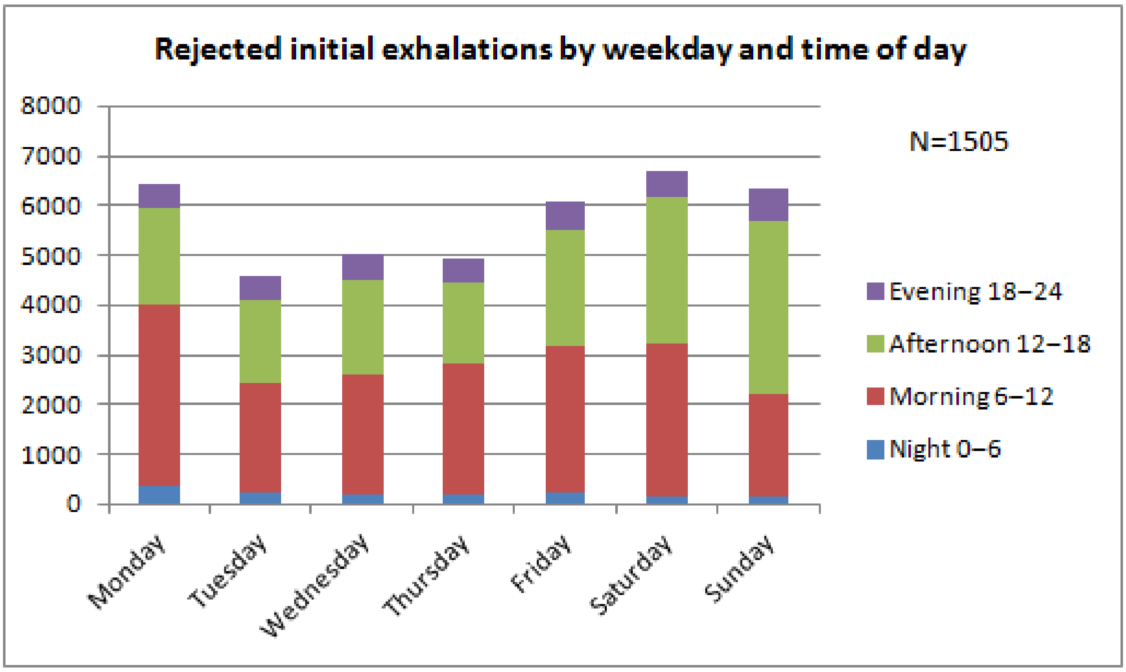

Figure 2. Rejected initial exhalations by weekday and time of day.

Recommendations

There are several development recommendations formulated as an outcome of the evaluation study. Most of the recommendations focus on the process of the national interlock program for the Finnish DUI offenders: 1) Driving bans ordered for driving while intoxicated should be lengthened to equal the length of the probationary period of controlled driving rights, and also to make to interlock driving licence more appealing to the offenders; 2) A normal driving licence should be restored to the driver only once the alcohol interlock's log data is found to contain no rejected exhalations in the past six months; 3) A health care professional should evaluate each individual's need for discussion sessions, e.g. from one to three sessions; and 4) A short driving ban before receiving alcohol interlock-controlled driving rights should be considered for all persons caught driving while intoxicated.

Furthermore, the outcomes of the study speak for 1) More communication on alcohol interlocks and alcohol interlock-controlled driving rights; 2) Clarifying instructions drawn up on alcohol interlock-controlled driving rights for district courts, police departments and health care professionals; 3) A log data register defined and maintained by the authorities to store the decoded log data of all alcohol interlock manufacturers or their representatives in a uniform format; and 4) Device manufacturers and importers improving the user instructions of alcohol interlocks and continuing technical development to alleviate problems related to, e.g. exhalations and warming up.

Conclusion

Alcohol interlocks used in controlled driving rights have prevented several thousand (12 000) instances of driving while intoxicated since July 2008. The recidivism rate of alcohol interlock users is significantly smaller than that of all persons convicted of driving while intoxicated. 64% of the interlock driving licence holders told that the interlock affected the use of alcohol for them. One-tenth had stopped drinking altogether. One third of the interlock users are keeping the device in their vehicle even after the supervision period is completed.

To sum up, the experiences and feedback on the use of interlocks, and their effectiveness on DUI prevention, traffic safety and also on harmful alcohol consumption is very promising. However, several shortcomings were identified in the process of alcohol interlock-controlled driving rights. It is crucial to eliminate these shortcomings to make alcohol interlock use more common, with the positive effects on traffic safety it entails.

References

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Road and Traffic Injuries of Workers on the Road to and from Place of Work in the Philippines

Context: In the Philippines, road accidents are prevalent due to various factors- structural, policy lapses, and structural in nature. The issue being addressed at in this paper is the injury on the road to and from work which is classified as occupational injury.

Objectives: To identify the prevalence from existing records of road injuries of workers and employees on their way to and from their place of work, or while carrying out their work outside the workplace. Hospital-based surveys and records were also sources of data for this study.

Key Outcomes: Occupational injuries in the Philippines showed 22,265 cases in 2003, and 47,235 cases in 2007. Injury occurred at 6 cases per 500 full-time workers, or 1 injury case for every 88 workers in 2000. Superficial injuries and open wounds were the most common type of injuries in 2000, 2003 and 2007. There was a total of 9,521 injury cases reported for the first quarter of 2010 in 77 government and private hospitals in the country. The cause of injury mostly occurred on the road (44.4%), at home (22.9%), leisure-related (20.2%), and of unknown place of occurrence (17.8%). Work-related injuries were reported at 7.8%. The injuries were reported to mostly occur between 4:00PM and 7:59PM. Of the total injuries, 0.47% led to death (NEISS-DOH, 2010) The highest number of overall cause of injuries was vehicular accidents with 3,077 cases. This was followed by mauling with 1,757 cases (14.83%) and contact with sharp objects with 1,130 cases (13.06%). Injuries were recorded highest in Central Luzon (34.1%), followed by Davao Region (13.5%). More males (83%) than females (17%) were injured. Meanwhile, the most common types of injuries were open wound/laceration at 3,821 cases (40.1%), abrasion at 3,361 cases at (35.3%) , and contusion at 1,618 cases (17%) (NEISS-DOH, 2010).

Discussion: It is suggested that data collection on occupational injuries be a national scale, and not merely randomized collection of data. Policies must be crafted to prevent occupationally related road injuries.

Key Words: Road Injury, Traffic Injury, Occupational Injury, Disabling Injuries, Accidents, Disabilities

INTRODUCTION

Occupational injury is any injury (i.e. cuts, fractures, sprains, and amputations) which results from work accident or from exposure involving a single incident in the work environment. Occupational accident is an unexpected and unplanned occurrence related to work that results to injury, disease or death whether outside the usual workplace (i.e., in another establishment, on travel, transport or in road traffic. It involves all accidents occurring out of or in the course of work including accidents "going to and fro" the place of employment (BLES-DOLE, 2010)[1].

Occupational injuries are one of the major health problems in developing countries (Ghods, 2009)[2] which is estimated by the World Health Organization (WHO) and the International Labor Organization (ILO), to be causing deaths of about 1.1 million people yearly because of unsafe and unhealthy work environments (Barcelona, 2009) [3].

In 2002, the Bureau of Working Conditions (BWC) stated that there were only 59 accredited workplace inspectors assigned to monitor more than 700,000 registered enterprises (Estrella-Gust, 2006) [4]. In 2007, only 280 labour inspectors all commissioned to monitor 800,000 registered firms in the country. This implies that there is inadequate number of labour inspectors who will monitor all registered firms in the country.

The objective of this study was to provide a detailed profile and statistics on occupational injuries in the Philippines. The latest national data on occupational injury in the country was 2007, and as such, analysis was limited up to this year. There were also years prior to 2007 not available in the national database of the Bureau of Labor and Employment Statistics. In line with this, this study also includes some recommendations that will be able to enhance the recording of occupational injuries and accidents in the country.

METHODOLOGY

The study collated and analyzed available data from national and international sources. Hospital-based and population-based data on types of injury such as motor vehicle crashes, falls, burns, drowning, poisoning, and suicides were included in the study in order to get a comparative statistics for occupationally related injuries compared to overall injuries in the country. Data were gathered mainly from the records of Bureau of Labor and Employment Statistics (BLES) of the Department of Labor and Employment (DOLE), Labor Force Survey of National Statistics Office, Occupational Safety and Health Center (OSHC), National Electronic Injury Surveillance System (NEISS) under Department of Health (DOH), Overseas Employment Statistics (OES) of the Philippine Overseas Employment Administration (POEA), and International Labor Organization (ILO). Thorough and systematic study reviews of literature, articles, surveys, case studies, and other data on injuries in the Philippines on electronically available literature were also done.

In this study, occupational injuries were presented by category- by incapacity for work, by frequency rate, severity rate, and average workdays lost, by major occupational group, by type of injury, by cause of injury, by part of body injured, and by agent of work-related injury.

RESULTS

1.0 Labor and Employment Statistics

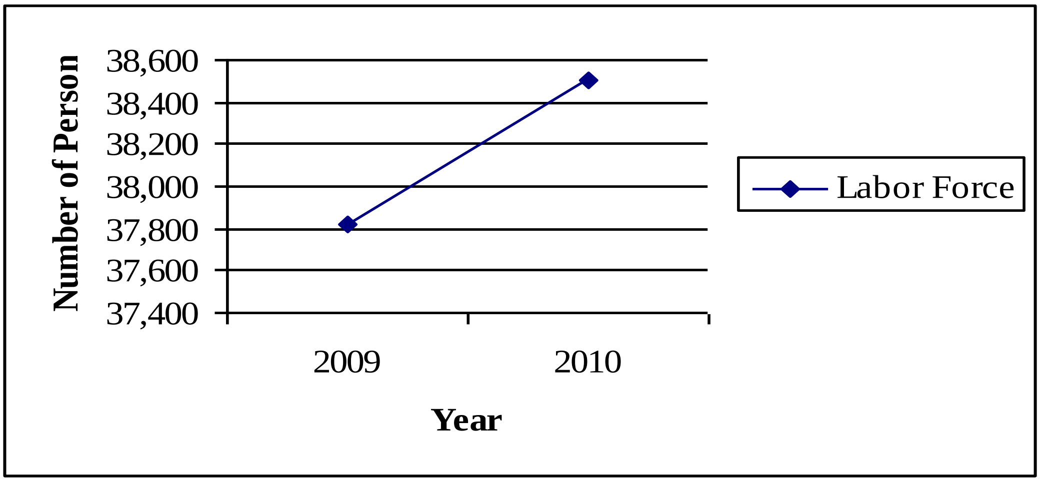
The current population of the Philippines is 94 million. The country's Gross National Product (GNP) is P 2,478.8 billion (USD56.34B) and the Gross Domestic Product (GDP) is P 2, 205.5 billion (USD50B) (NSO, 2010) [5].

Out of the estimated the total population of 60.2 million consisting of 15 years old and above in 2010, 36.5 million Filipinos were employed. The employment rate was 92.7%, and the labor force participation rate was at 64.5% (as of January 2010) (NSO, 2010) [5].

Labor force comprises of potential workers, either actually employed or unemployed. Labor force participation rate is the proportion of the total number of persons in the labor force to the total population (15 years old and above). Employment rate is the proportion of total number of employed persons to the total number of persons in the labor force. Underemployment is a term used to designate a worker whose current employment leads him to desire to have additional hours of work in their present job or in an additional job, or to have a new job with longer working hours (NSO, 2010) [5].

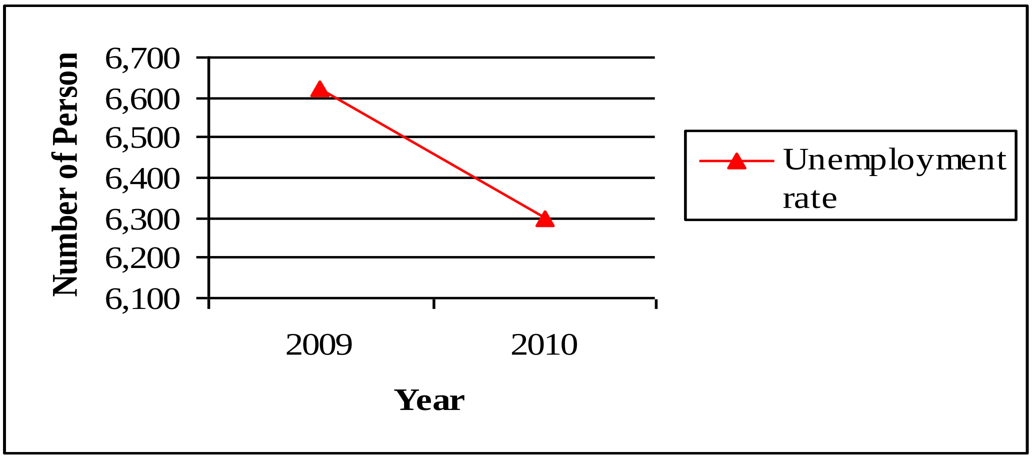
The country's labor force grew by 1.8% from 37,824 in 2009 to 38, 508 in 2010. See Figure 1. The employment rate decreased by 0.5% as of April 2010, whereas the unemployment rate increased by 0.5% coinciding with the economic crisis that started in the United States of America. Underemployment rate, which is defined as the rate of graduates being employed in sectors other than their degree courses, decreased by 1.1% from 6, 621 in 2009 to 6,298 in 2010 (NSO, 2010)[5]. See Figure 2.

Figure 1. Country's Labor Force in 2009 to 2010



Source: National Statistics Office, 2010[5].

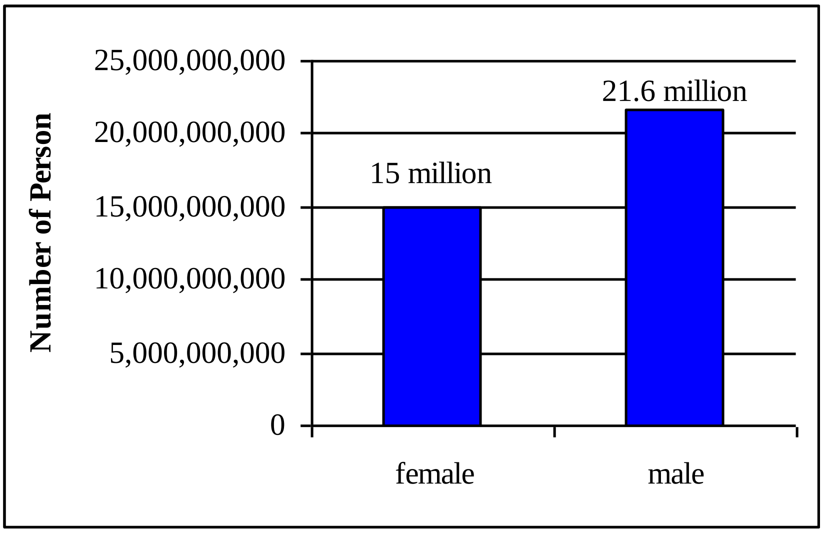
Figure 2. Unemployment Rate in 2009 to 2010



Source: National Statistics Office, 2010[5].

The Philippines has a relatively young population and young workforce. In 2009, 45% of the total number of employed persons were 25 to 30 years old. This was followed by ages 20-24 years old. There were 21.6 million males and 15 million females employed in 2010, registering a male-female employment ratio of 1.44: 1.0. This means that for every 1.44 males, there is only 1 female employed (NSO, 2010)[5]. See Figure 3.

Figure 3. Employment Ratio by Gender



Source: National Statistics Office, 2010[5].

Overseas employment is also significant because of its contribution to dollar remittance to the country, thus, boosting local economy, as well as attendant issues on occupational hazards and safety that go with it. While the Department of Foreign Affairs reports that there are about 7.38 to 8 million Filipino migrants throughout the world, there are about 1.2 million Overseas Filipino Workers (OFW) employed in major land groupings. Majority of the OFWs work in the Middle East (669,042) followed by Asia (260,995) and Americas (31,146) (NSCB, 2009)[6].

2.0 Occupational Injury and Hazard Exposure

Occupational injuries is a global problem. According to the World Health Organization (WHO) and the International Labor Organization (ILO) (Haspels et.al., 1999) [7], 1.1 million people die annually due to hazardous, unsafe and unhealthy work environments. Out of the estimated 250 million accidents in the workplace, about 300, 000 result in partial or complete loss of capacity to work and to generate income. Occupational injuries are therefore costly for the worker, the company, and the local economy. In 2003, ILO reported that there were about 358,000 fatal and 337 million non-fatal occupational accidents in the world (Barcelona, 2009)[3]. Given these statistics, it is necessary that preventive and control measures be implemented at work to prevent hazardous exposures, and governments should come up with policies and laws for workplace safety and health.

3.0. Local Situationer

Occupational injuries in the Philippines showed 58,720 cases in 2003, and 46,570 cases in 2007. The manufacturing industries registered the highest number of cases at 40,498 cases in 2003 and 30,790 cases in 2007. Real Estate, Renting and Business Activities had the highest decrease at 60.57% from 1,022 cases in 2003 to 403 in 2007. On the other hand, private education services had the highest increase at -76.54%. See Figure 4.

In the year 2000, records from BLES-DOLE showed that there were 26, 289 non-fatal cases in 2000, and 20,270 cases in 2007. Among the non-fatal cases, 26,110 cases led to temporary disability in 2000 and 20, 109 temporary disabilities in 2007. It is alarming to note that out of the reported cases of occupational injuries, 178 resulted in death in 2000, and 116 deaths in 2007. These statistics only show the reported cases which may be minimal compared to the overall fatalities occurring as a result of occupational injuries including unreported cases. Permanent disability is also a grave consequence of occupational injury. Permanent disabilities registered at 179 in 2000, and 162 in 2007. See Table 1.

Table 1. Cases of Occupational Injuries in All Industries by Incapacity for Work in 2000 and 2007

Type of Injury with Workdays Lost	**2000**	**2007**
Fatal	178	116
Non-fatal	26, 289	20,270
Permanent	179	162
Temporary	26,110	20,109
Total Cases with Workdays Lost	**26,467**	**20,386**

Source: Bureau of Labor and Employment Statistics (BLES) Integrated Survey, 2010[1].

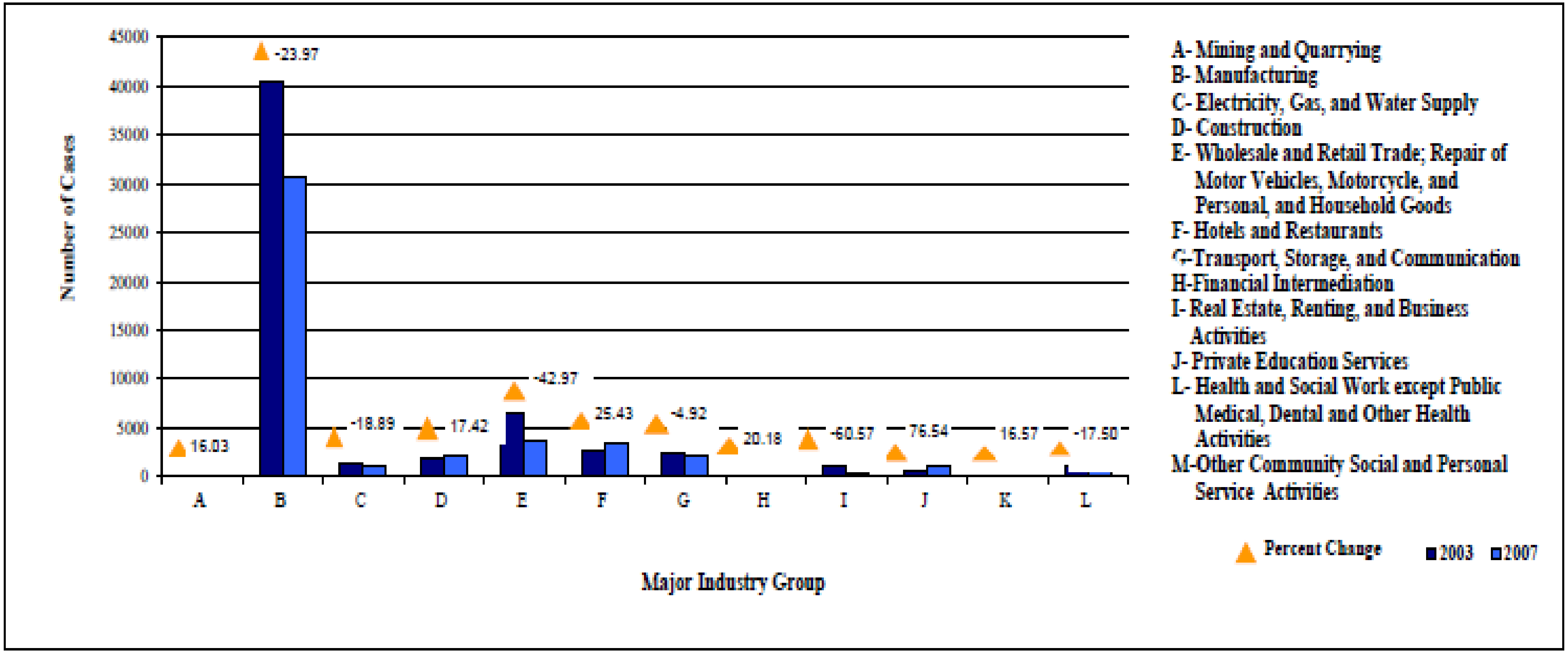
As for the frequency rate of injury, it was estimated to occur at 6 injury cases per 500 full-time workers, or 1 injury case for every 88 workers in 2000. In the following years, it declined to 4 cases per full-time worker in 2003, and 3 cases for every 88 workers in 2007. The severity rate of injury in the year 2000 was relatively high registering 44 per 500 full-time workers. This led to an average of 8 workdays lost due to occupational injuries in all types of industries. See Table 2.

Table 2. Cases of Occupational Injuries by Frequency Rate per 500 Workers, and Severity Rate per 500 Workers in the Years 2000, 2003, and 2007

Occupational Injury	**2000**	**2003**	**2007**
Total Occupational Injuries[8]	69,208	58,720	46,570
Frequency Rate (%)[1]	5.70	4.07	2.79
Fatal[1]	0.04	0.03	0.02
Non fatal[1]	5.66	4.04	2.77
Permanent Incapacity	0.04	0.02	0.02
Temporary Incapacity	5.62	4.02	2.75
Severity rate (%)[1]	43.69	27.31	19.05
Average Days Lost[1]	8	6.79	6.92

Source: Bureau of Labor and Employment Statistics (BLES) Integrated Survey, 2002[8], 2010[1].

Figure 4. Cases of Occupational Injuries by Major Industry, 2003 and 2007



Source: Bureau of Labor and Employment Statistics (BLES) Integrated Survey, 2010[1].

Superficial injuries and open wounds were the most common type of injuries in 2000, 2003 and 2007 but this declined by 28.6% from 14, 925 cases in 2000 to 10,517 cases in 2003 and it further declined by 10.4% in 2007. Acute poisoning and infections rapidly increased by 2.39 times from 2003 to 2007. Other serious injuries were burns, corrosions, scalds, and frostbites and still registering with 2,065 cases in 2007. Fractures also registered at 1,839 cases in 2007. See Table 3.

Table 3. Cases of Occupational Injury by Type in the Years 2000, 2003, and 2007 in all Industries

Type of Injuries	**2000**	**2003**	**2007**
Superficial Injuries and Open Wounds	14, 925	11,609	10,517
Fractures	1,151	1,927	1,839
Dislocations, Sprains and Strains	2,789	3,336	2,366
Amputations	354	547	234
Concussion and Internal Injuries	1,963	1,048	694
Burns, Corrosions, Scalds and Frostbites	1,944	2,300	2,065
Acute Poisoning and Infections	347	221	750
Foreign Body in the Eye	1,793	1,848	1,565
Others	1,202	430	356
Total	**26,468**	**23,265**	**20,386**

Source: Bureau of Labor and Employment Statistics (BLES) Integrated Survey, 2010[1].

From 2000 to 2007, injuries to upper extremities had the highest number of cases followed by lower extremities and head. Injury to the head is a disturbing statistics as this may lead to serious consequences. The least injuries were to the neck. See Table 4.

Table 4. Cases of Occupational Injuries by Part of the Body Injured in the Years 2000, 2003, and 2007 in All Industries

Part of the Body	**2000**	**2003**	**2007**
Head	3,486	3,875	2,626
Neck	137	170	263
Back	651	992	739
Trunk or Internal Organs	354	484	643
Upper Extremities	13,678	10,366	10,212
Lower Extremities	6,256	6,695	5,158
Whole Body or Multiple Sites Equally Injured	969	683	745
Others	934	-	-

Total	26,465	23,265	20,386

Source: Bureau of Labor and Employment Statistics (BLES) Integrated Survey, 2010[1].

Hospital-Based Records of Injuries including Vehicular Accidents

Based on hospital records, there was a total of 9,521 injury cases reported for the first quarter of 2010 in 77 government and private hospitals all over the Philippines. The cause of injury mostly occurred on the road (44.4%), at home (22.9%), leisure-related (20.2%), and of unknown place of occurrence (17.8%). Work-related injuries were reported at 7.8%. The injuries were reported to mostly occur between 4:00PM and 7:59PM. Of the total injuries, 0.47% led to death (NEISS-DOH, 2010a)[9]. See Table 5.

The highest number of overall cause of injuries was vehicular accidents with 3,077 cases. See Figure 6. This was followed by mauling with 1,757 cases (14.83%) and contact with sharp objects with 1,130 cases (13.06%). Injuries were recorded highest in Central Luzon (34.1%), followed by Davao Region (13.5%). More males (83%) than females (17%) were injured. Meanwhile, the most common types of injuries were open wound/laceration at 3,821 cases (40.1%), abrasion at 3,361 cases at (35.3%) , and contusion at 1,618 cases (17%) (NEISS-DOH, 2010b)[10]. See Figure 7.

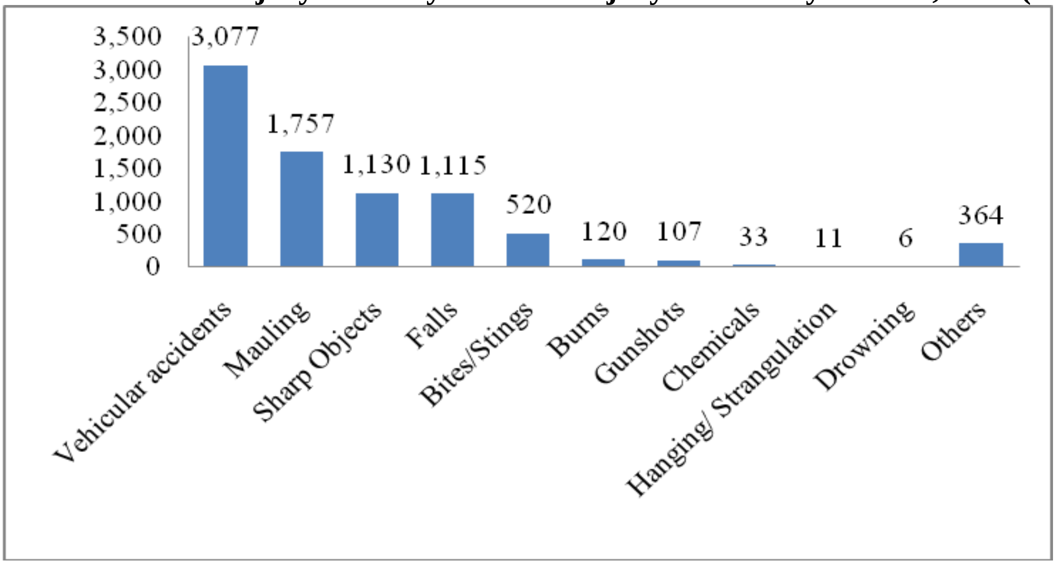
Table 5. Hospital-Based Records of Occupational Injuries from January to April, 2010 (N=9,521)

Hospital-Based Records	Frequency	Percentage
Cause of Injury		
Vehicular accidents	3,077	32.32
Mauling	1,757	18.45
Contact with Sharp Objects	1,130	11.87
Fall	1,115	11.71
Bites/Stings	520	5.46
Burns	120	1.26
Gunshots	107	1.12
Chemicals/ Substances	33	0.35
Hanging/ Strangulation	11	0.12
Drowning	6	0.06
Others	364	3.82
Not Accounted	1281	13.45
Type of Injury (multiresponse)		
Open Wound/Laceration	3,821	40.13
Abrasion	3,361	35.30
Contusion	1,618	16.99
Closed Fracture	745	7.82
Avulsion	298	3.13
Concussion	216	2.27
Open Fracture	167	1.75
Burn	146	1.53
Traumatic Amputation	33	0.35
Others	1,114	11.70

Age group		
15-44	5,236	55
65 and above	286	3
>5 years old	666	7
Others	3333	35

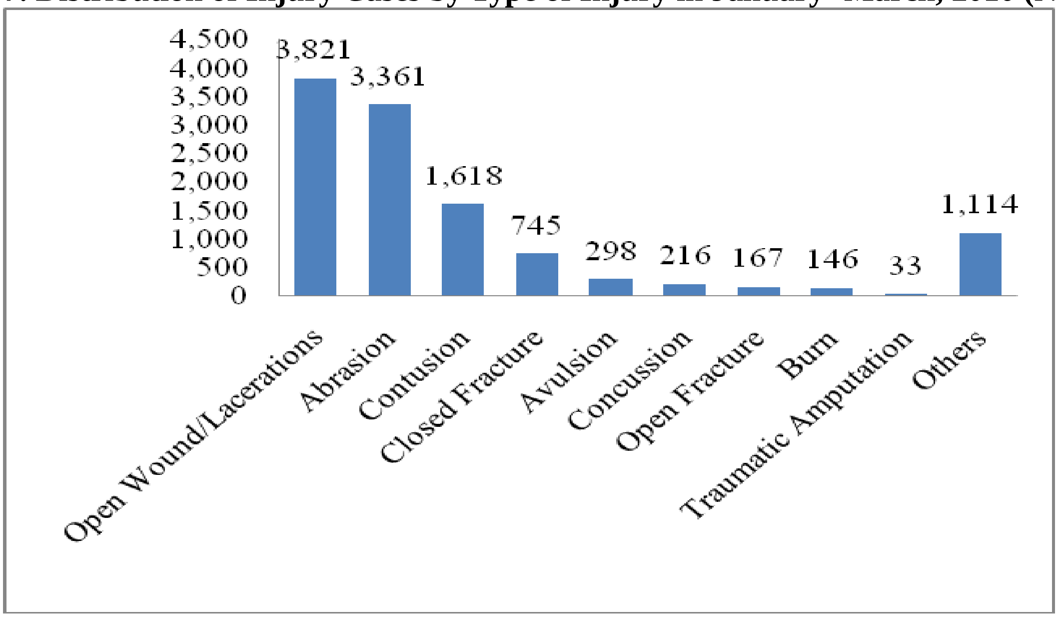
Source: National Electronic Injury Surveillance System (NEISS)- Department of Health (DOH), 2010a[9].

Figure 6. Distribution of Injury Cases by Cause of Injury in January- March, 2010 (N=9,521)



Sources: National Electronic Injury Surveillance System (NEISS)- Department of Health (DOH), 2010a[9].

Figure 7. Distribution of Injury Cases by Type of Injury in January- March, 2010 (N=9,521)



Sources: National Electronic Injury Surveillance System (NEISS)- Department of Health (DOH), 2010a[9].

Burn cases can be both a cause and a type of injury. There were 120 cases (1.26%) of burn injuries as a cause of injury, and 146 cases (15.3%) as a type of injury (NEISS-DOH, 2010a)[9]. In UP-PGH Burn Unit in 1995, a total of 211 patients were admitted due to burn injuries. In another study, sixty-eight patients suffered burn injuries secondary to electrical injury (Acosta et.al., 1999) [11].

Cases of homicides and suicides as a form of intentional injury also exist in the Philippines. The most recent report shows 11,240 cases of homicide and 885 cases of suicide in 1998 (WPRO, 2004) [12].

Occupational Injuries- Local Researches

Occupational injuries and accidents occur in all occupational groups and across industry types. The study of Lu (2009) [13] reveals that the prevalence of work-related occupational injuries in the electronic industries is prevalent. The results showed significant association between muscle injury with vibration hazard from tools, low back injury with excessive work, eye strain with poor illumination, slipping with poor housekeeping, falls with slippery floor and uneven floors. Furthermore, an international study in electronics assembly showed certain types of injuries such as burns from soldering iron or hot plate; cuts due to razors, tweezers, knives; eye strain due to work with small parts, computer monitor, microscope work; and eye injuries from splashes and contamination of chemicals used such as alcohol, soldering fumes, cleaning solvents (Azaroff et. al., 2004) [14].

Another study among seafarers from different countries including Philippines showed that 9.1% of the all seafarers were injured at one point or another during the course of their work. Among the injuured, 4.3% had at least 1 day of incapacity (Jensen et.al., 2005) [15].The most common injury reported by the seafarers was slips, trips, and falls- related injuries (43%). This was followed by fractures and sprains at 42%.

Among rural workers consisting of farmers and fisherfolks, they experience usually wide range of occupational hazards (BWC, 2009)[16]. The farmers experience pesticide-related illnesses, injury to the eyes due to pesticide mists, skin allergies and dermatoses, injuries from sharp objects, accidents form agricultural implements and tractors, gastro-intestinal diseases form contact with microbes and biologic agents in soil and water, skin cancers and cataracts form prolonged exposure to sunlight, musculoskeletal disorders such as back pain from heavy work, and bad body biomechanics such as excessive lifting, bending, twisting, pushing and pulling. snake bites, and insect bites, respiratory illnesses due to exposure to extreme weather conditions (BLES-DOLE, 2010)[1]. In the agricultural sector, pesticide poisoning is one cause of occupational injury. The rate of occupational acute pesticide poisoning in the Philippines accounted for about 4% of the total injuries recorded in 2007. On the other hand, the fishermen or fisherfolks also experience similar hazards and illnesses. The latter suffer injuries from explosives, splinters, sharp tools, prolonged immersion of hands and feet in water and exposure to polluted water (e.g. red tide) (BWC, 2009) [16].

The construction is another hazardous industry in the Philippines. The construction workers are exposed to several hazards such as falls from heights, abrasions from sharp tools, vibration from drilling equipments, electrocution from live wire, eye and lung irritations from cement dusts, asbestosis form asbestos containing paints especially in stripping off old paints and ceilings, noise induced hearing loss form noisy machines and mixers, cuts and lacerations nails, hammer and saw accidents, respiratory problems from varnish, thinners and paints, gastro-intestinal problems from eating unhygienic foods, and generally unhealthy condition form crammed living quarters, lack of toilet facilities, and sleeping in the construction site itself (BWC, 2009)[16]. OHSC reported that, 51 deaths and 8 injuries occurred among construction workers in 22 workplace incidents in 2010. Eleven of the total number of deaths occurred in construction area (OSHC, 2002)[17]. In April 2010, the Trade Union Congress of the Philippine (TUCP) reported 5 deaths in Cebu construction sites, and 10 deaths from mining accidents in Nueva Vizcaya (TUCP, 2010)[18]. A most recent incident in the Philippines is the reported case involving the use of electric gondola that killed 10 workers in a construction project in Makati City. The workers died of multiple fractures, head trauma, and blunt trauma. Overloading, mechnaical defect an dlack of personal protective equipments like harness and hard hats were the main reason for the accident (GMANews.TV, 2011)[19]. A similar incident happened in Malaysia wherein 3 workers were injured related to the use of gondola (DOSH, 2008) [20].

The miners are also beset with hazards, injuries, accients and deaths. A survey in a gold mining operation in Benguet showed that out of the 88 workers employed, 65 had suffered injuries, mostly suffering from lacerations, crushing injuries, bruises, and fractures. The prevalence of injury and accident in the said mining operation was found high at 74% (National Objectives for Health Philippines, 2005-2010)[21]. On the other hand, the Institute for Occupational Health, and Safety Development (IOHSAD) reported 11 cases of death of miners recorded in the second half of 2007 alone. Two miners died of suffocation in Tuba,Benguet, and 2 more miners died in Mankayan, Benguet due to the caving in of the underground tunnel. Another 2 miners died in Itogon, Benguet after inhaling poisonous gas used in the mining operations (IOHSAD, 2008) [22].

The service sector such as the nursing profession also encounter occupationally-related injuries that are different form the injuries in the agricultural and manufacturing industries. In a study among Filipino nurses, 40% of the 4,800 nurses all over the Philippines had experienced at least one injury (i.e., back injury and needlestick injuries) in 2008. Most who had injury did not report the injury. They considered the injury either as insignificant or routinely part of their job (de Castro et. al., 2009)[23].

DISCUSSION

The data above show that there were 26,467 injury cases in 2000 and 26,289 cases in 2007. Among the non-fatal cases, 26,110 cases led to temporary disability in 2000 and 20, 109 temporary disabilities in 2007. It was also reported that out of the reported cases of occupational injuries, 178 resulted in death in 2000, and 116 deaths in 2007. The reported severity rate of injury in the Philippines was 19 injury cases per 500 workers in 2007, and an incidence rate of 7 cases per 500 workers. This severity and incidence rates, however, do not show segregation by occupational groupings. There are some occupational groupings that would register higher in injuries compared to other occupations. In China, for instance, the severity ratio of occupational injuries in the construction was 82.7 (Jovanovic et.al., 2004)[26]. In Iran, the injury rate is lower than that in the Philippines at 18 injury cases per 500 workers in 2004 (Ooshaksaraie et. al., 2009)[27], and the incidence rate was 4 cases per 1000 persons from 2002 to 2006.

The average workdays lost in the Philippines in 2007 was 6.92 days. The data on workdays lost in the Philippines are not segregated according to the type of injury. The figure can well go up for serious injuries and accidents. In China for instance, occupational injuries particularly in chemical industry resulted in a mean of 69 workdays lost (Jovanovic et.al., 2004)[26].

The most common causes of occupational injuries in all industries in the Philippines were due to stepping on, striking against, or struck by objects, followed by situations being caught in or between objects, and then instances being struck by flying or falling objects. In another study,factors such as fatigue, multi-job, family problems, and using of medicines were found to be responsible or cause of 53.6% of all occupational accidents (Ghods, et.al., 2009)[2]. In China, the major causes of injuries among the workers in chemical industry were being struck by flying or falling objects, collision and being compressed by mechanical or other object and equipment (Jovanovic et.al., 2004)[26]. Furthermore, in China, falls from height, falls on the same level, and traffic accidents were prevalent in the construction industry (Jovanovic et.al., 2004)[26]. The review of data in the Philippines also shows similar incidents of falls from height.

In the Philippines, 14.9% of the total injuries in the Philippines in 2007 accounted for eye injuries. In the United States (U.S.), agricultural workers experience eye injuries and illness at a rate of 8.7 per 10,000 workers, and this is twice higher than the rate in the general working population in the U.S. at 3.8 per 10,000 (Luque, 2007) [28]. The Philippine data do not show the rate of eye injury and illness coming from the agricultural sector. There are various eye irritants in the agricultural sector such as exposure to dust, sand, tools, branches, allergenic agents, pesticides, wind, sun, water, and insects (Forst et. al., 2004)[29]. These irritants that get into contact with the eyes can acuse infections, allergic reactions, eye irritations, and corneal and other eye trauma (Luque, 2007)[28].Many of these eye injuries are due to hazards from pesticide exposure (Rainbird and O'neil, 1995)[30].

In the agricultural sector, pesticide poisoning is also one cause of occupational injury. As shown above, the rate of occupational acute pesticide poisoning in the Philippines accounted for about 4% of the total injuries recorded in 2007. In Ecuador which is also an agricultural society, the rate of occupational acute pesticide poisoning among the agricultural workers was 171 cases per 100,000 persons during the years 1991 to 1992. In the U.S., 243 agricultural workers suffered lost-work-time injuries, and about 5 percent of this resulted in permanent disability (NIOSH, 2008) [31]. The most common cause of occupational injuries among these farmers in the U.S. were musculoskeletal in nature such as constant bending, twisting, carrying heavy items, and repetitive motions during long work hours.

The data also showed the occupational injuries of nurses in the Philippines. Nurses experience at least one injury per year. In Brazil, a study among the health workers showed that the most frequently experienced injury was percutaneous needlestick injury. This type of injury posed a high risk of HIV transmission to the health workers (Marino et. al., 2001)[32].

Excessive hours of work and heavy workload can lead to fatal incident or trigger suicide attempts. The reported death of a garment worker in one hospital in Cavite, Philippines was alleged to be due to overfatigue from work (Hazard Magazine, 2010)[33]. In the year 1998, there were 885 cases of suicide recorded in the Philippines (WPRO, 2004)[12]. In Japan, reports of sharp increase of "karojisatsu" or work-related suicide were cited. According to the National Police Agency Statistics in Japan, out of the 31,042 suicides in 2001, 1,756 were alleged to be company-related, including employees who had been reprimanded by employers and superiors for work-related faults and errors. There are more cases of company- and work-related suicides in Japan. A Toyota Motor Corp employee in Japan took his own life in 1988 due to overfatigue (The Japan Times, 2003)[34]. The same was the fate of another Japanese national who had worked 17 months without a day off, and only half an hour's sleep a night (Workers' Health International Newsletter, 1996)[35]. In Britain, a family doctor hanged herself due to stress at work (Hazard Magazine, 2010)[33]A woman factory worker in a Reebok-producing shoes in Indonesia died after doing excessive overtime (Workers' Health International Letter, 1996)[35].

Given the generalities of data and statistics gathered and documented by the Bureau of Labor and Employment Statistics and concerned agencies of the Department of Labor and Employment, there needs to be improvement in data collection, data segregation per industry groupings, representativeness of data on a national scale, and more rigorous dissemination to the public and private sectors. Meanwhile, companies and establishments should be more cognizant of and more readily comply with their responsibilities. Provisions and enforcement of sanctions for non-compliance should be also be done. Given the limited number of inspectors nationwide, only 280 in all, monitoring 800,000 registered firms in the country, it is virtually impossible to implement and enforce occupational safety rules and regulations.

CONCLUSION

The data on occupational injuries in the Philippines showed major trends in injuries, causes of injuries and rates and severity of injury. However, the data lack more specific and segregated information per industry and occupational grouping, as well as identification of risk factors associated with these injuries. Therefore, improvements in injury surveillance and documentation of injury cases as well as research into risk factors at work should be done. All these efforts should lend towards prevention strategies and guidelines on occupational injuries in the Philippines. Also, there is a need to have a standard nomenclature of occupational injuries, starting from the primary data sources (company clinics) which are the bases of the national data.

It is suggested that data collection on occupational injuries be on a national scale, and not merely randomized collection of data from small, medium and large industries. Data on occupational injury should also include the agricultural sector, the informal sector, and small enterprises which are also important sectors in the Philippine economy.

The overseas workers are also an important segment of the labour force considering their critical size and their remittances to the Philippines. Currently, OFWs are not covered by the occupational health and safety surveillance structure of the Philippines (WHO WPRO) [36]. Hence, there is a necessity for inclusion of occupational safety nets for these workers while working abroad, and when returning back from an occupationally related illness or injury. The Overseas Workers' Welfare Association gives trainings and education programs to the OFWs prior to being deployed to their country of employment. Prevention of occupational injuries and fatalities is one of the training programs. However, these trainings should also include how to report to their employer the illnesses/accidents that might happen to them due to work exposures. In case the employer fails to notify the Labor Department, the employee may then go to the nearest office branch of Employees Compensation Division and should fill in and submit a "Notification of Accident Form." They should be advised to keep a file of their medical records and documentations (Tellez, 2000)[37]. There should be a detailed procedure of reporting/documentation of work-related injuries and illnesses. Binghay (2006)[38], in his study among the Overseas Filipino Seafarers, recommended that there should be ongoing and aggressive social dialogue among the major stakeholders and the governments of the receiving and sending countries to promote decent work among migrant workers. An overseas work policy position on prevention of injuries and fatalities should be forged with countries taking in our labour force. This bilateral agreement is now initiated and being forged between the Philippines and the Republic of Korea, and the same should be pursued with other countries.

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On-site testing of cannabis. A controlled study after smoking cannabis

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Abstract

Background
Collection and analysis of drugs in oral fluid using conventional on-site test devices is time consuming, often taking more than 10 minutes. The BIOSENS® system, utilizes an alternative approach which implies collection of mucus from the mucosal surface from the tongue with a special designed Oral Mucus Collector (OMC), subsequently analyzed in a BIOSENS® system. The collection procedure takes a few seconds and the analysis procedure approximately 60 seconds.

Aims
To determine the window of detection and cut off values for THC (Δ-9-tetrahydrocannabinol) using the BIOSENS® system after smoking one single cannabis cigarette.

Methods
Eight subjects smoked one cannabis cigarette (Δ-9 THC content 0.3mg/kg body weight). Conventinal oral fluid samples and oral mucus samples were collected prior smoking and 1, 2, 3, 4, 5, 6h after smoking. The mucus samples were collected using a BIOSENS® Oral Mucus Collector and conventional oral fluid samples were collected with Quantisal Oral Fluid Devices (Immunalysis) subsequently analyzed for THC at laboratory.

The clinical part of the study was conducted at the Faculty of Psychology and Neuroscience, Maastricht in the Netherlands.

Results
The window of detection using the BIOSENS® system was found to be 4 hours for four of the eight subjects, 3h for one subject, 2h for one subject, 1h for one subject and less than 1h for one subject. The cut off values were calculated from the conventional oral fluid samples (Quantisal), at 20ng/ml 71% sensitivity was achieved and at 80ng/ml 94% sensitivity was achieved with the BIOSENS® system The specificity was 100% (No false positives)

Discussion and conclusions
The window of detection after smoking a single cannabis cigarette were 3-4hours and the very short sample collection/analysis time (<2min) opens up possibilities to detect DUI (Driving Under Influence) in practical way. The window of detection is similar to the acute impairment window reported elsewhere. Apart from cannabis, we have observed that other drugs are accumulated in the mucosal surface of the tongue as well. The overall results

showed that the BIOSENS® system is applicable as an efficient screening method for detecting recent drug use.

Introduction

Detection of cannabis is known to be a problem for most on-site oral testing devices. The collection and analysis of a saliva sample using most on-site oral devices is reported to take more than 10 minutes for non-drug takers and considerable longer when taking samples from persons under influence of certain drugs[1,2]. The BIOSENS® system is based on the principle that drug molecules are accumulated in mucus on the mucosal layer on the tongue, which can be collected by a simple wiping procedure. It takes approximately five to ten seconds to acquire sufficient amount of the mucus for a BIOSENS® analysis. The high efficacy in the collection of drugs is explained by the principle that drug molecules are accumulated on the surfaces giving a fortified concentration compared to the surrounding oral fluid. Apart from cannabis (THC) the accumulation effect has been observed for other drugs such as opiates, cocaine and amphetamines, which can be explained by hydrophobic interaction as well as ionic trapping to the negatively charged mucosal layer of the tongue.

Experimental

Study Objectives

To determine the window of detection and cut off values for Δ-9 THC measured by the BIOSENS® system after smoking one single cannabis cigarette.

Study design

The study was conducted at the Faculty of Psychology and Neuroscience, Maastricht in the Netherlands in accordance with ethical principles as enunciated in the Declaration of Helsinki in compliance with The Netherlands law. (Principal Investigator Jan Ramaekers). Mucus samples for BIOSENS® analysis and conventional oral fluid samples for laboratory analysis (Quantisal collector devices) were taken before and at different intervals after smoking cannabis or tobacco cigarette. The Cannabis cigarettes were prepared beforehand for each individual by using Medicinal Cannabis from the Cannabis Bureau in the Netherlands. The Δ-9 THC-content was adjusted individually to the body weight (0.3mg/kg) and mixed with tobacco to a standard sized cigarette. The Δ-9 THC content in the cannabis was 11%. Eight volunteers smoked one cannabis cigarette (volunteer 4, 5, 6, 7, 8, 10, 11 and 12) and four volunteers smoked one tobacco cigarette without cannabis (subject 1, 2, 3 and 9).

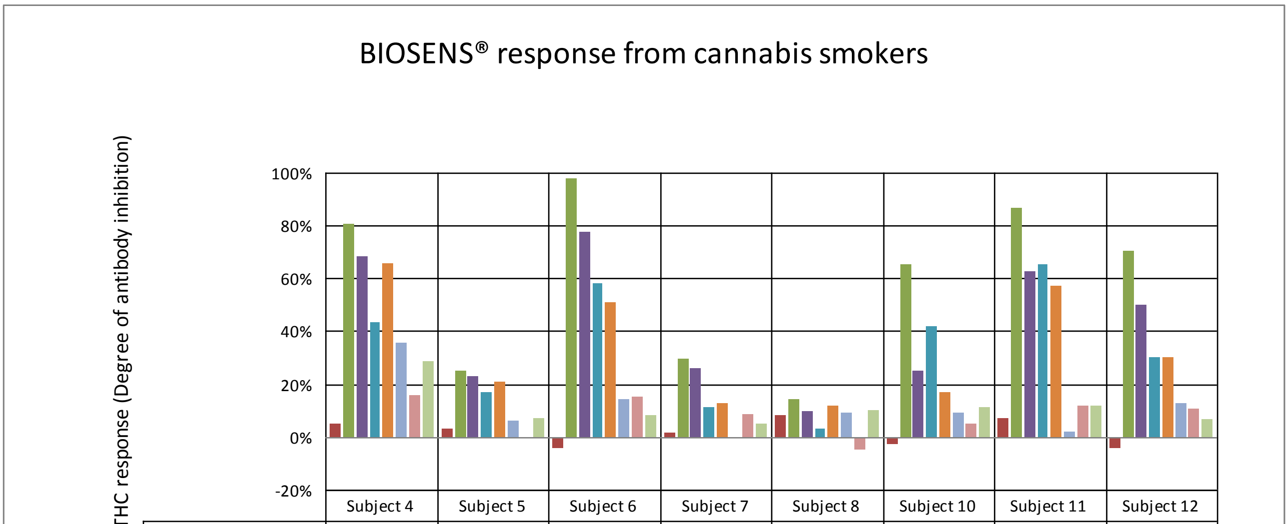
Oral mucus collection and analysis using the BIOSENS® system.

The BIOSENS® system consists of a desorption unit, an extraction unit and a sensor unit. The mucus samples were collected by wiping the tongue a few seconds using a BIOSENS® Oral Mucus Collector (OMC), which were heated in the desorption unit in the system to desorb and transfer the drugs in the sample to a cold "finger", subsequently extracted in the extraction unit with a small volume of buffer containing a known amount of antibodies against the various drugs that were to be detected in the system. The mixture of inhibited and active antibodies was introduced into the sensor unit in the system after a few seconds inhibition time. The sensing principle to detect presence of antibodies is based on Surface Acoustic Wave technology (SAW)[3]. The SAW sensor chip in a BIOSENS® system contains 12 different SAW-sensors that are individually surface coated with an antigen analogue selective against a specific antibody. When a drug is present in the sample, the drug will inhibit all or parts of its specific antibody and the SAW-sensor will respond by a decrease in the response providing information of the presence (or absence) of the drug in the mucus sample. Thus a response of 100% means a complete inhibition of the antibodies. The method is very rapid (about 1-2 minutes for sampling and analysis).

Laboratory analysis of THC in oral fluid by liquid chromatography-mass spectrometry (LC/MS)
Conventional oral fluid samples were collected with Quantisal collection devices, subsequently analyzed for THC at Immunalysis Corporation, 829 Towne Center Drive, Pomona, CA) using LC/MS/MS-technology. (Liquid Chromatography/Mass-Spectrometry,). The limit of quantification for THC was 1ng/ml.

Results and discussion

Window of detection
Figure 1 and 2 shows the response data obtained by using the BIOSENS® system from samples collected from the eight cannabis smokers at different times after smoking. Samples showing an inhibition value close to 100% indicate a high concentration of THC. No false positives were observed from mucus samples taken before smoking cannabis or in samples taken from persons smoking only tobacco cigarettes in the study. The figures show substantial inter-individual variations as well as intra-individual variations. The low BIOSENS® responses in the Subjects # 5, 7 and 8 correlate very well with the low THC-concentrations obtained from laboratory analysis of conventional oral fluid samples. (Figure 3). The cut off values for the BIOSENS® were found to be 20ng/ml at a sensitivity of 71% and 80ng/ml at a sensitivity of 94% . The elimination half-lives of the THC in the samples vary between the subjects but did not differ from published data (half-life around 1-1.5h)[4].



	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8	Subject 10	Subject 11	Subject 12
0h (before smoking)	5%	3%	-4%	2%	8%	-3%	7%	-4%
1h after smoking	80%	25%	98%	30%	14%	65%	87%	70%
2h after smoking	68%	23%	78%	26%	10%	25%	63%	50%
3h after smoking	43%	17%	58%	11%	3%	42%	65%	30%
4h after smoking	66%	21%	51%	12%	12%	17%	57%	30%
After meal (at 4h)	35%	6%	14%		9%	9%	2%	13%
5h after smoking	16%	0%	15%	9%	-5%	5%	12%	11%
6h after smoking	28%	7%	8%	5%	10%	11%	12%	6%

Fig.1: THC responses obtained of the BIOSENS® system from oral mucus samples collected from cannabis smokers at different times after smoking. The subjects had a meal after 4 hours

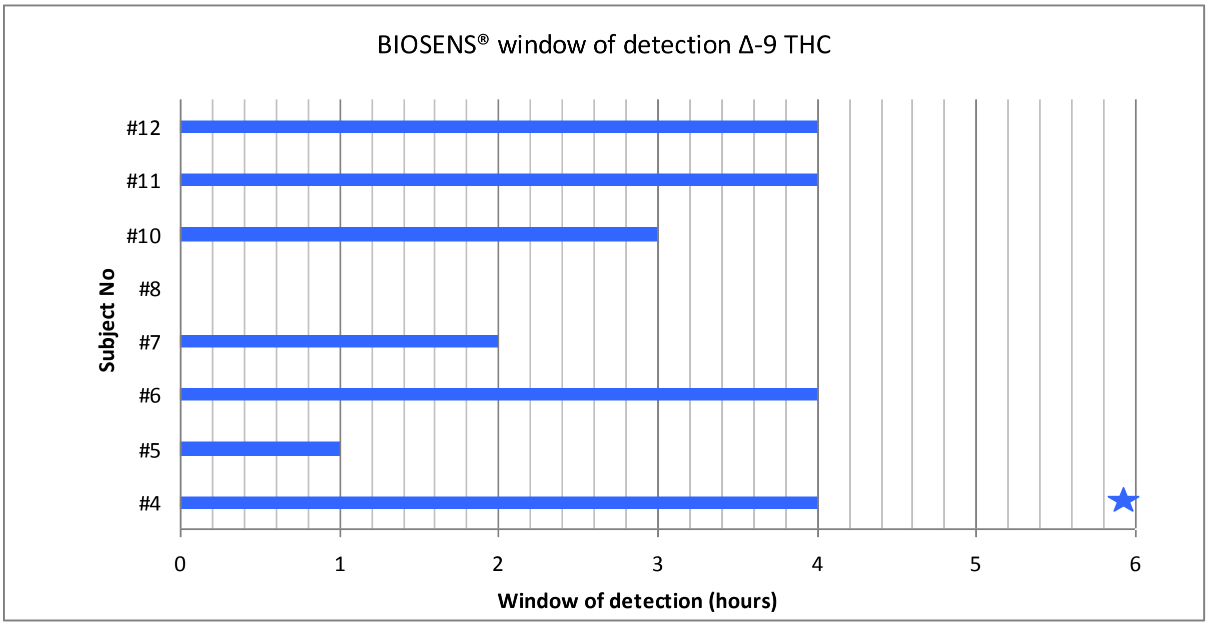
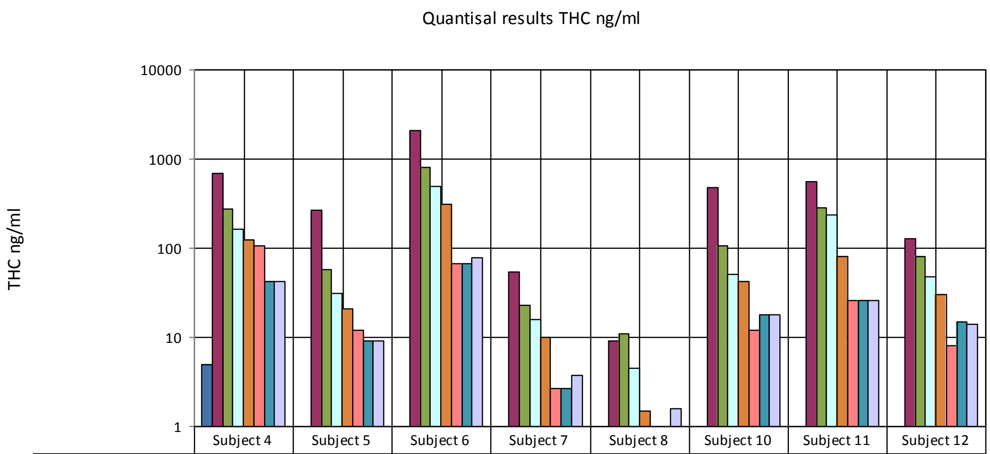


Fig.2: Window of detection of THC in oral mucus samples after smoking one cannabis cigarette



	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8	Subject 10	Subject 11	Subject 12
0h (before smoking)	5	0	0	0	0	0	0	0
1h after smoking	693	266	2096	54	9	481	563	128
2h after smoking	276	57	795	23	11	107	283	81
3h after smoking	164	31	489	16	4,5	51	236	48
4h after smoking	123	21	316	10	1,5	42	81	30
After a meal	106	12	68	2,7	0	12	26	8
5h after smoking	42	9	68	2,7	0	18	26	15
6h after smoking	42	9	78	3,8	1,6	18	26	14

Fig.3: THC concentration in oral fluid samples taken by Quantisal devices and analyzed by Liquid Chromatography/Mass-Spectrometry, LC/MS/MS

Conclusion

The results showed that the BIOSENS® system is an applicable and accurate tool for detecting recent cannabis smoking and relating impairment. The whole procedure including collection and analysis of an oral mucus sample took between one and two minutes and provides high sensitivity and low false positive rate. The results from the study confirmed that BIOSENS® "wiping collection technique" utilizes the fact that the concentration of Δ-9 THC is higher in the mucus sample from the surface of the tongue compared to samples of oral fluid collected by conventional methods

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Risk of driving when positive for psychoactive substances

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Abstract

Background
Driving with alcohol imposes an increased risk of injury, but the knowledge about other drugs is limited.

Aims
This paper aims to assess the risk of driving with alcohol, illicit drugs and medicines in various European countries.

Method
The risk of getting seriously injured or killed in an accident for a driver positive for a given substance was calculated with a case-control design as the odds ratio (OR) using logistic regression. For risk of serious injury, cases consisted of samples from 2,490 drivers admitted to hospitals in six countries and controls of 15,832 non-injured drivers from roadside surveys in the same countries. For fatality risk, cases consisted of 1,112 killed drivers in four countries and controls of 21,917 non-injured drivers from roadside surveys in the same countries. The risk estimates for serious injury and fatality for each substance were adjusted for age, gender and country.

Results
The results were based on risk estimates and their confidence intervals. The highest risk of getting seriously injured or killed was associated with BAC above 1.2 g/L and alcohol combined with other substances (OR between 20 and 750). Other high risk groups were drivers with BAC between 0.8 g/L and 1.2 g/L, multiple drugs and amphetamines (OR between 5 and 30). Medium increased risk was found for BAC between 0.5 and 0.8 g/L, cocaine, benzoylecgonine, illicit opiates and medicinal opioids (OR between 2 and 10). Slightly elevated risk was associated with cannabis and BAC between 0.1 g/L and 0.5 g/L (OR between 1 and 3).

Discussion and conclusion
Risk of serious injury or fatality for drivers positive for the various substances was significantly above 1. However, high alcohol concentrations and the combination of alcohol and other drugs showed the highest risk and alcohol is therefore still the main problem in traffic compared to other psychoactive substances.

Background

The use of psychoactive substances can influence people's motor and cognitive performance, and, consequently, be a hazard to traffic safety. Alcohol is a well-known contributor to road accidents (Moskowitz and Robinson 1987, Moskowitz and Fiorentino 2000), but other substances, such as illicit drugs and psychoactive medicines, can also adversely affect the fitness to drive, and, therefore, endanger traffic safety (Assum et al. 2005, Movig et al. 2004).

Aims
The objectives of this paper is to assess the relative risk for drivers who have been seriously injured or killed in traffic accidents while driving with alcohol, illicit drugs and medicines.

Method
To assess the risk of getting seriously injured or killed in a car accident, a population-based case-control design was chosen. Collection of data from seriously injured, killed and roadside survey is described in the following.

In total nine countries took part in the study of relative risk of serious injury/fatality while positive for psychoactive substances. Six countries contributed to the study on the relative risk of getting seriously injured: Belgium, Denmark, Finland, Italy, Lithuania and the Netherlands. Four countries contributed to the study on the relative risk of getting killed: Finland, Norway, Portugal and Sweden.

In order for the roadside survey to serve as the control sample and the data collected in the hospitals to serve as the case sample for the calculation of relative risk, the regions for the two types of studies should cover the same areas in a country.

Study	Country	Collection period controls	Collection period cases	Controls	Cases
Risk of serious injury	Belgium	2008-2009	2008-2010	2,949	348
	Denmark	2008-2009	2007-2010	3,002	839
	Finland	2007-2009	2008-2010	2,706	54
	Italy	2008-2009	208-2009	1,086	676
	Lithuania	2008-2009	2008-2010	1,267	385
	The Netherlands	2007-2009	2008-2010	4,822	188
Risk of fatality	Finland	2007-2009	2006-2008	3,841	478
	Norway	2008-2009	2006-2008	9,236	193
	Portugal	2008-2009	2009	2,641	285
	Sweden	2008-2009	2008	6,199	156

Table 1. Participating countries, data collection periods and number of samples.

Data collected in the roadside surveys
A number of regions were selected for the studies in the various countries, depending on the willingness of the police to cooperate in stopping drivers at the roadside. Sampling design was stratified according to region, road type and time of day. Within each stratum drivers were stopped at random. Only drivers of passenger cars and vans (hereafter named drivers) aged 18 and above were included in the study.

After being stopped by the police, standardised anonymous information on the drivers was gathered by research teams and a saliva and/or blood sample was collected. However, in some of the countries, the alcohol concentration was based on a breathalyzer test. The following information was mandatory: age, gender, type of vehicle, road type and time and date of the control.

Data from the roadside survey was weighted according to the national distribution of traffic in eight time periods of the week, in which the prevalence was assumed not to vary substantially. Weighted prevalence was calculated, including confidence intervals.

Data collected from seriously injured drivers

Five hospitals were selected in Belgium and Denmark, 2 in Finland, 4 in Italy and Lithuania and 3 in the Netherlands, preferably in the same regions as the roadside surveys. Only drivers aged 18 and above were included in the study. The interval between accident and blood sampling had to be less than 3 hours in order for the toxicological analysis to reflect as much as possible the drug concentration at the time of the accident. Only drivers with a Maximum Abbreviated Injury Scale (MAIS) ≥2 or equivalent were included. A MAIS score was not available in Denmark and Italy, but other criteria were considered to guarantee inclusion of patients with an injury severity equivalent to MAIS score 2 or higher.

Standardised information on the patients and their accidents was gathered. The following information was mandatory: age, gender, type of vehicle and type of accident (single/multi vehicle), time and date of accident and of blood sampling, medication/fluids administered prior to blood sampling, MAIS-score.

Data collected from killed drivers

Information on drugs in killed drivers was obtained from blood samples that had been collected in connection to the accident investigation. Blood samples from killed drivers obtained from traffic accidents in the study periods cf. table 1, as well as similar information as for the seriously injured patients formed the data material.

Toxicological analyses

All blood- and saliva samples were analysed by means of fully validated methods (Badawi et al. 2009). Samples were analysed for the same substances in all countries. As the information about whether a subject was positive for a substance or not, came from toxicological analyses of samples from both blood and saliva, it was crucial for this study that equivalent cut-offs for blood and saliva were developed in order to be able to compare the saliva-positive subjects with the blood-positive subjects. This means that concentrations of both blood and saliva could be included in the calculations. These equivalent concentrations were developed in the DRUID project (Verstraete et al. 2011) which solves the problem of two different specimens being collected in the roadside surveys. Furthermore, it enables the calculation of relative risk based on saliva in the control study population and blood in the case study population. In countries where alcohol was based on breath, the conversion factor between breath and blood was set to 2100.

The following results are based on concentrations of the substances in question that are equal to or exceed the above-mentioned equivalent concentrations in blood and in saliva. If both a saliva sample and a blood sample were analysed, the concentration in blood was used for this sample. THCCOOH alone was left out since this metabolite cannot be found in saliva.

As for the toxicological findings in seriously injured drivers, in case the blood sample was positive for a drug that corresponded to the medicine administered before the blood sample was taken, then this concentration was considered negative.

For the results of the toxicological findings, drugs were grouped according to their pharmacological characteristics. Substances of the same type were combined into substance 11 groups: alcohol, amphetamine/methamphetamine/MDA/MDEA/MDMA, benzoylecgonine, cocaine/cocaine+benzoylecgonine, THC/THC+THCCOOH, illicit opiates, benzodiazepines, z-drugs, medicinal opioids, alcohol+drug(s), multiple drugs (Hels et al., 2011)

Calculation of the relative risk for a car driver of getting seriously injured or killed in a road accident while positive for alcohol and other drugs
The relative risk for a driver of getting seriously injured or killed in an accident while positive for a given substance was calculated as the ratio between the odds for a driver of getting seriously injured/killed in an accident while positive for a given substance and the odds of getting seriously injured/killed while negative. The odds ratios were calculated by means of logistic regression using the SAS 9.2 procedure proc logistic.

As the case study population, the data from the hospital studies of seriously injured drivers and the study samples of killed drivers were used. As the control study population, the data from the roadside surveys in the same countries, weighted for the national distribution of traffic in each of eight time periods of the week were used and (Hels et al. 2011). The relative risk estimates were adjusted by age, gender and country. For the purpose of comparison, crude odds ratios were also computed.

Results

Relative risk of getting seriously injured or killed
Aggregated risk estimates based on data from several countries for seriously injured drivers and killed drivers are shown in table 2 and 3. Both crude odds ratios as well as odds ratios adjusted for age, gender and country were calculated. However, as indicated in tables 2 and 3, Finland and Italy were left out of the risk calculation regarding alcohol due to suspected bias in the data collection of drivers at the roadside, and Sweden because alcohol positive drivers were not included in the control sample. Furthermore, the risk estimates for some of the illicit drugs vary to a high degree among the single countries; risk estimates for other illicit drugs are based on few positive samples with the result of very wide confidence intervals. Therefore the aggregated estimates for illicit drugs are uncertain.

Substance group	**Countries**	**Crude OR**	**C.I.**	**Adjusted OR**	**C.I.**
Negative (reference)		1.00		1.00	
All alcohol	DK, LT, BE, NL	7.71	*6.61-8.99*	8.27	*7.03-9.74*
0.1g/L≤alcohol<0.5g/L	DK, LT, BE, NL	1.07	*0.74-1.55*	1.18	*0.81-1.73*
0.5g/L≤alcohol<0.8g/L	DK, LT, BE, NL	4.03	*2.62-6.20*	3.64	*2.31-5.72*
0.8/L≤alcohol<1.2g/L	DK, LT, BE, NL	14.27	*8.91-22.84*	13.35	*8.15-21.88*
Alcohol≥1.2g/L	DK, LT, BE, NL	54.45	*39.00-76.02*	62.79	*44.51-88.58*
All illicit drugs alone	DK, FI, IT, LT, BE, NL	2.89	*2.13-3.91*	2.35	*1.72-3.21*
Amphetamines	DK, FI, IT, LT, BE, NL	9.65	*4.63-20.11*	8.35	*3.91-17.83*
Benzoylecgonine	DK, FI, IT, LT, BE, NL	4.91	*2.17-11.12*	3.70	*1.60-8.57*
Cocaine	DK, FI, IT, LT, BE, NL	2.83	*1.21-6.64*	3.30	*1.40-7.79*
THC	DK, FI, IT, LT, BE, NL	1.84	*1.18-2.87*	1.38	*0.88-2.17*
Illicit opiates	DK, FI, IT, LT, BE, NL	2.40	*0.50-11.45*	2.47	*0.50-12.10*
All medicines alone	DK, FI, IT, LT, BE, NL	3.59	*2.84-4.55*	4.13	*3.22-5.28*
Benzodiazepines and Z-drugs	DK, FI, IT, LT, BE, NL	1.72	*1.19-2.50*	1.99	*1.36-2.91*
Medicinal opioids	DK, FI, IT, LT, BE, NL	8.00	*5.73-11.18*	9.06	*6.40-12.83*
Alcohol-Drug combination	DK, LT, BE, NL	32.74	*21.16-50.66*	28.82	*18.41-45.11*
Drug-Drug combination	DK, FI, IT, LT, BE, NL	8.67	*5.85-12.85*	8.01	*5.34-12.01*

Table 2. Relative risk for a driver of getting seriously injured while positive for various substances.

Substance group	Countries	Crude OR	C.I.	Adjusted OR	C.I.
Negative (reference)		1.00		1.00	
All alcohol	N, PT	37.64	*29.36-48.24*	34.90	*27.00-45.11*
0.1g/L≤alcohol<0.5g/L	N, PT	9.23	*6.07-14.05*	8.01	*5.22-12.29*
0.5g/L≤alcohol<0.8g/L	N, PT	42.94	*21.99-83.86*	45.93	*23.02-91.66*
0.8/L≤alcohol<1.2g/L	N, PT	34.81	*16.02-75.65*	35.69	*15.68-81.22*
Alcohol≥1.2g/L	N, PT	450.37	*224.06-905.25*	500.04	*238.07-inf.*
All illicit drugs alone	FI, N, S, PT	3.85	*2.17-6.80*	3.55	*1.97-6.42*
Amphetamines	FI, N, S, PT	25.44	*10.81-59.90*	24.09	*9.72-59.71*
Benzoylecgonine	FI, N, S, PT	6.87	*1.49-31.76*	n.a.	
Cocaine	FI, N, S, PT	22.34	*3.66-136.53*	n.a.	
THC	FI, N, S, PT	1.80	*0.73-4.44*	1.33	*0.48-3.67*
Illicit opiates	FI, N, S, PT	10.04	*2.04-49.32*	n.a.	
All medicines alone	FI, N, S, PT	5.05	*3.80-6.72*	5.29	*3.95-7.08*
Benzodiazepines and Z-drugs	FI, N, S, PT	5.11	*3.72-7.02*	5.40	*3.90-7.46*
Medicinal opioids	FI, N, S, PT	4.82	*2.61-8.88*	4.82	*2.60-8.93*
Alcohol-Drug combination	N, PT	41.22	*22.59-75.24*	31.52	*16.83-59.05*
Drug-Drug combination	FI, N, S, PT	16.77	*9.95-28.27*	18.51	*10.84-31.63*

Table 3. Relative risk for a driver of getting killed while positive for various substances.

Based on the odds ratios in table 2 and 3, together with odds ratios calculated for each of the countries in the study (Hels et al., 2011), and taking into account the uncertainty of some of the risk estimates, an overall and general estimation of the size of the relative risk by substance group is shown in table 4.

Risk level	Risk factor	Substance group
Slightly increased risk	1-3	0.1 g/L ≤ alcohol in blood < 0.5 g/L THC
Medium increased risk	2-10	0.5 g/L ≤ alcohol in blood < 0.8 g/L Benzoylecgonine Cocaine Illicit opiates Benzodiazepines and Z-drugs Medicinal opioids
Highly increased risk	5-30	0.8 g/L ≤ alcohol in blood < 1.2 g/L Amphetamines Multiple drugs
Extra highly increased risk	20-200	Alcohol in blood ≥ 1.2 g/L Alcohol in combination with drugs

Table 4. Relative risk of getting seriously injured or killed for various substance groups by relative risk level.

As indicated in table 4, the main problem is high alcohol concentrations and alcohol combined with other psychoactive substances. Other problem groups are medium alcohol concentrations, multiple drug use and amphetamines. Medium increased risk was found for alcohol concentrations between 0.5 and 0.8 g/L, for cocaine and for the medicine groups included in the study. The risk associated with benzoylecgonine that is not an active agent might be caused by sleep deprivation after cocaine consumption. The risk associated with THC seems to be similar to the risk when driving with a low alcohol concentration.

Discussion and conclusions

For the first time, so many European countries have been part of a risk study where the risk estimates have been adjusted for both age, gender and country.

High alcohol concentrations and the combination of alcohol and other drugs show the highest risk. In general, the relative risk of the various drug groups show values that are significantly above 1 but alcohol is still the main problem in traffic compared to other psychoactive substances.

Participating institutions in the project

Apart from the authors’ institutions, the following institutions participated in the studies: Section of Forensic Chemistry, Department of Forensic Medicine, University of Copenhagen, Denmark, National Institute for Health and Welfare, Alcohol and Drug Analytics Unit, Finland, Norwegian Institute of Public Health, Swedish National Road and Transport Research Institute, State Forensic Medicine Service under the Ministry of Justice of the Republic of Lithuania, University of Padova, Italy, National Institute of Legal Medicines, Portugal and Institut Belge pour la Sécurité Routière.

Disclaimer

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Screening for criminality as a long-term indicator of impaired driving

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Abstract

Background

While several screening instruments exist for evaluation of DWI offenders, screening instruments geared toward general delinquency are rare. This study provided an opportunity to examine whether a screening instrument originally designed to over-sample those at risk of delinquent behavior has utility for predicting alcohol and/or drugged driving over the lifespan.

Aims

This study examines the ability of a 10-item screening tool developed to identify young men at high risk for criminal behavior to predict drunk and/or drugged driving later in life.

Methods

The original sample, comprised of 625 males aged 16-19 from Buffalo, NY, was obtained in 1992 using RDD methods. Screening items included getting into fights from age 8-11, and drinking regularly before age 15. Males scoring positive on ≥three items were attempted to be recruited; a comparison group was recruited part of the time. A follow-up survey of these men now in their 30s was conducted with 78% of the original respondents (n=486) to study drinking and/or drugged driving across the lifespan. Data was analyzed regarding: driving while feeling the effects of alcohol, any drug other than alcohol, or alcohol and another drug simultaneously; perception of driving when having had too much to drink; driving within two hours of drinking; and driving within four hours or within one hour of using any drug other than alcohol.

Results

No statistically significant associations were found between screening positive and the drinking and driving variables. However, screening positive was indicative of drugged driving.

Discussion and conclusions
Results suggest that drugged drivers may be a subtype of impaired drivers who are more likely to have other criminal involvement than those who report only drinking and driving, because the screening was designed to correlate with risk for criminality.

Introduction and Background

The World Health Organization (WHO) affirms that driving while impaired from the effects of alcohol and/or other drugs has a major negative impact on traffic safety in the United States as well as throughout the world (WHO, 2009). While several screening instruments are available for the purpose of evaluating driving-while-intoxicated (DWI) offenders (Chang, Gregory, and Lapham, 2002), screening instruments geared toward general delinquency are far rarer. A longitudinal study of young men (ages 16-19), conducted in four waves and spanning a period of about 15 years, has provided a unique opportunity to examine whether a screening instrument originally designed to over-sample those at risk of engaging in general delinquent behavior may have utility in the specific prediction of alcohol and/or drugged driving over the lifespan.

Methods

The original sample for this study consisted of 625 young men aged 6-19 recruited from Buffalo, New York, by random-digit-dial for the Buffalo Longitudinal Study. Respondents at high risk of engaging in criminal behavior were over-sampled using a screening instrument consisting of a set of 10 items chosen for their probable ability to be indicative of delinquency. Screening items included indicators such as whether the potential respondent had ever repeated a grade in school, whether a parent was ever absent for six months or more while the respondent was growing up, and whether the respondent had consumed alcohol once a month or more before the age of 15 (see all 10 items in Table 1 below).

Eligible males scoring positive on three or more items were attempted to be recruited; a comparison group (i.e., screened positive on <three items) was recruited part of the time, resulting in a 72-to-28% breakdown of study versus comparison subjects.

Table 1. Screening instrument items.

Screening question	**Score point for:**
Did you ever repeat a grade in school?	Yes
Are you currently in high school or college?	No
Did you finish high school?	No
Did you ever get in fights when you were 8-11 years old?	Yes
Were your parents ever absent for 6 months or more while you were growing up?	Yes
Did you have the same, more, or fewer rules than other kids your age?	Fewer
Did you drink once a month or more before age 15?	Yes
Did you smoke cigarettes regularly before age 15?	Yes
Did your parents think your friends were troublesome?	Yes
Did you attend four or more grade or high schools?	Yes

In the first three waves of face-to-face interviews (18 mos. apart), data was collected on demographics, as well as data on a wide variety of topics, including alcohol and drug use and involvement with illegal activities (e.g., violence, property crime, etc.). At each wave, respondents were asked how many times they had driven a motor vehicle while feeling the effects of alcohol in the last twelve months, a measure suggested by Elliott et al (1985). Over 95 percent of the sample was retained by the end of the three waves.

The focus of the Wave 4 study was different from that of the original study, with an aim of studying the initiation and continuation of substance-use impaired driving activity within the sample. Due to the amount of time that had elapsed since the conclusion of the third wave, the transient nature of the majority of the original respondents, and the fact that several respondents had died (n=26) and upwards of 50 had either served time in prison or are still incarcerated, the final n for Wave 4 was smaller at 486 (follow-up rate of 78%).

Given the focus of Wave 4, six additional substance-use impaired driving measures were added to the original item (Elliott et al, 1985) used in Waves 1-3. The additional items assessed: perception of driving when having had too much to drink; driving within two hours of drinking; driving while feeling the effects of any drug other than alcohol; driving within four hours of using any drug other than alcohol; driving within one hour of using any drug other than alcohol; and driving while feeling the effects of alcohol and another drug simultaneously. All measures were asked with regard to the previous 12-month period.

Results

Cross-tabulation of screening done at Wave 1 (negative screen if respondent scored fewer than three; positive if scored three or more) with each of the seven impaired driving outcomes at Wave 4 yielded results as shown in Table 2. For each of the three drinking and driving outcomes, an interesting pattern existed wherein results were opposite of what one might initially expect; drinking and driving was reported more frequently among those with a negative screen, significantly so for the measure “driving within two hours of drinking” (χ^2=4.0, $p<.05$).

Strikingly, the pattern, though not statistically significant, was in the hypothesized direction with regard to screening positive and reporting drugged driving, as well as driving while feeling the effects of both alcohol and another drug simultaneously.

To further examine the possible association of positive screening with the substance-impaired driving outcomes, the single screener “Did you drink alcohol regularly before age 15?” was analyzed separately with each outcome. Again, an unexpected relationship existed between positive screening on underage regular drinking and driving within one hour of using any drug other than alcohol (χ^2=3.6, $p<.05$). The screener had no significant association with any of the other outcomes.

Table 2. Screening score by impaired driving variables at Wave 4, last 12 months (n=486)

	Screening score	
Impaired driving measures at Wave 4, last 12 months	**Less than 3 (%)**	**3 or more (%)**
Drinking and Driving…		
…while feeling the effects of alcohol	39.0%	34.9%
…when you've had perhaps too much to drink	29.5%	23.7%
…within two hours of having a drink	57.5%*	47.6%*
Drugging and Driving…		
…while feeling the effects of any drug (not alcohol)	16.3%	21.0%
…within four hours of using any drug (not alcohol)	17.7%	22.5%
…within one hour of using any drug (not alcohol)	14.3%	18.0%
Driving…		
…while feeling the effects of alcohol plus another drug	8.8%	11.5%

*χ = 4.0, $p<.05$

The emergence of unexpected relationships between the screener and the alcohol-related driving outcomes prompted an examination of each of the ten separate screening items with the one alcohol-related outcome that existed in all four waves of data: Driving while feeling the effects of alcohol (last twelve months). Table 3 shows results of these cross-tabulation analyses. Some interesting results were obtained, including significant inverse relationships between having repeated a grade in school and driving while feeling the effects of alcohol in Waves 2-4. The results that really stand out, however, are those of the positive relationships between regular cigarette smoking and drinking before the age of 15 with driving while feeling the effects of alcohol at Waves 1-3; particularly noteworthy is that fact that these relationships disappeared by Wave 4.

Table 3. Screening items by drinking and driving outcome, Waves 1-4, last 12 months (n=486)

		Driving while feeling the effects of alcohol, last 12 months (%)			
Screening item		**Wave 1**	**Wave 2**	**Wave 3**	**Wave 4**
Repeated a grade in school	**YES** No	n.s.†	21.0% 28.6%*	26.1% 36.6%**	31.3% 41.3%*
Currently in H.S. or college	Yes **NO**	13.4% 31.5%***	22.2% 32.3%*	n.s.†	n.s.†
Finished high school	Yes **NO**	n.s.†	n.s.†	n.s.†	n.s.†
Got in fights from ages 8-11	**YES** No	n.s.†	n.s.†	n.s.†	n.s.†
Parents absent for ≥6 months	**YES** No	n.s.†	n.s.†	n.s.†	n.s.†
Had fewer rules than other kids	**YES** No	n.s.†	30.2% 22.1%*	n.s.†	n.s.†
Drank regularly before age 15	**YES** No	35.2% 13.3%***	37.0% 21.2%***	42.7% 28.2%**	n.s.†
Smoked cigs regularly before age 15	**YES** No	35.9% 14.0%***	36.4% 22.2%**	46.0% 28.0%***	n.s.†
Parents thought friends troublesome	**YES** No	n.s.†	n.s.†	n.s.†	n.s.†
Went to ≥4 grade or high schools	**YES** No	22.8% 15.5%*	n.s.†	n.s.†	29.1% 40.5%**

†n.s .= not significant; *p≤.05; ** p≤.01; ***p≤.001

Discussion and Conclusions

The original aim of this study was to examine the ability of a 10-item screening instrument developed to identify young men at high risk for criminal behavior (e.g., violence, property crime) to predict drunk and/or drugged driving later in life. Results suggest that drugged drivers may be a subtype of impaired drivers who are more likely to have other criminal involvement than those who report only drinking and driving, because the screening was designed to correlate with risk for criminality. As mentioned before, there are several instruments already available for evaluating DWI offenders. The discovery that an instrument initially designed to screen for criminality has utility as a long-term indicator of drugged driving thus has important implications for traffic safety in a day and age where use of drugs other than alcohol (e.g., prescription drugs) are taking a front seat, albeit still second to alcohol use.

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Hair ethylglucuronide and blood phosphatidylethanol detection of 4 DUI driver risk factors[1]

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Abstract

Background
Ignition interlocks reduce recidivism while installed, a benefit lost once devices are removed. Iinterlock BAC test fail rates predict this post-interlock recidivism. Various alcohol biomarker types, sourced from urine, blood and hair predict interlock fail rates. Which biomarkers best predict recidivism and which would be the best components in a panel of markers to help evaluate drink-driving offenders?

Aims
The aim is to characterize risk indicators and outcomes among interlock participants. This paper focuses on new analyses comparing different marker types in prediction of 4 categories of criterion correlates or outcomes: recidivism, alcohol dependence, ordinal fail rates, maximal BAC attained during the first two interlock months.

Methods
Interlock offenders gave consent and interviews (for DSM4 diagnosis), self-report assessments (DRINC, AUDIT, TLFB) and contributed blood, hair, urine for analysis of GGT, MCV, ALT, AST, PEth-HPLC, PEth-LCMSMS, uEtG, hEtG, uETS, hFAEE, %CDT, γ%CDT. ROC analysis of interlock BAC test records and driver records yielded predictor and outcome variables.

Results
Hair EtG was the strongest predictor of baseline alcohol dependence and subsequent recidivism; it shared honors with PEth for predicting maximal recorded levels of BAC. PEth was the strongest predictor of failed BAC tests across 5 ordinal combinations of failed BAC tests, both overall and morning tests. γ%CDT was the best indirect marker. TLFB "drinks per drinking day" was the only interesting non-biomarker predictor. Hair EtG above either the 30 pg/mg cutoff (2/3 of drivers above) or the 50 pg/mg (1/3 of drivers above) is strongly associated with other self-report, diagnostic and interlock-based indicators of alcohol driving risk.

Discussion
PEth and hair EtG are the two best component alcohol biomarkers to include in a comprehensive monitoring panel for driver alcohol risk. Hair EtG overlaps little with other alcohol biomarkers in explaining variance. GGT and %CDT, while weaker, are the best indirect markers.

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Introduction

Interlock BAC test fail rates predict post-interlock recidivism. Various alcohol biomarker types, both direct and indirect sourced from urine, blood, and hair, predict interlock fail rates. This paper provides new analyses comparing different marker types in prediction of 4 criteria or outcomes: new recidivism, alcohol dependence, morning plus overall fail rates, and maximal BAC attained during the first two interlock months.

Marques et al., (2010) reported that the average levels of six different alcohol biomarkers: phosphatidylethanol (PEth), gamma glutamyltransferase (GGT), percent carbohydrate deficient transferrin (%CDT), alanine aminotransferase (ALT), aspartate aminotransferase (AST), macrocytic volume (MCV), measured at the start and the end of a period of interlock controlled driving, were largely unchanged (at the group level) over the mean 8 intervening months. Despite recidivism reductions, and an aggregate 50% reduction in rates of failed BAC test logged on the interlock device, drinking levels held constant during the interlock period even while drinking-driving declined by 2/3 (based on recidivism data). Declining recidivism and BAC test failures during the interlock had for some years been viewed as evidence of a reduction in drinking. The biomarker data suggests that view was premature.

An estimate of drinking proclivity would be useful before a driver is released from an interlock program. The BAC test fail rates from the interlock record are one source of information, but exclusive reliance on it could easily encourage actively monitored drivers to avoid the interlock car toward the end of the required time. Alcohol biomarkers are endogenous to the individual and so cannot be easily gamed, but there are many markers to choose from. What might be the best alcohol biomarkers for estimating drinking proclivity near the end of an interlock program?

The ability to anticipate driver risk based on the pattern of interlock BAC test fail rates has led several state governments to extend interlock time for these higher risk drivers. This is sensible policy, but it leaves unanswered the question: what explains the rapid reversion to control levels of recidivism once the interlocks are removed? Having attained some degree of accommodation to drinking AND driving, why would drivers change, and what do they change?

Blood and urine alcohol biomarkers can extend the surveillance window to detect drinking for several days to weeks or more after significant consumption. *Direct alcohol biomarkers* (PEth, EtG, EtS, FAEE) are ethanol itself, products of minor ethanol metabolic pathways, or are produced only in the presence of alcohol; since these directly reflect alcohol exposure they have higher sensitivity and specificity than indirect markers. *Indirect markers,* often thought of as disease markers, include (GGT, MCV, ALT, AST, CDT); these are liver enzymes, blood products, or physiologic reactions that occur after regular high levels of alcohol exposure.

Some alcohol biomarkers can be measured in hair (due to uptake and sequester from blood in the hair follicles) and extend the detection period to several months of past alcohol consumption. Høiseth et al. (2009) noted that hEtG shows the highest sensitivity relative to traditional biomarkers with levels proportional to the alcohol consumed. Pirro et al. (2011) reported hEtG to be the most accurate biomarker for the identification of heavy drinking. Liniger et al. (2010) concluded that hEtG is the best choice for assessing fitness in suspected drinking drivers.

The Society of Hair Testing (SoHT), concluded that 30 picograms of EtG per milligram of hair, estimated to grow 1 cm/month, is consistent with abuse levels of alcohol consumption. Dufaux et al. (2012) analyzed samples from German drivers seeking to reinstate driver licenses and found that the measurement of EtG in hair, with its longer time horizon, detected 12.7% positives relative to 2.1% positives found with the measurement of EtG in urine, a 6-fold detection improvement. These are stable findings based on sample sizes of 4000 and 13,000, respectively.

Methods

Subsequent to a DUI conviction, 534 interlock offenders (87% male, age 38.6 ± 12, 64% first offenders) signed informed consent documents, sat for interviews, and provided blood, hair and urine for alcohol biomarker determinations. The project was conducted in Edmonton, Alberta, Canada, at the Guardian Interlock Center. Interlock company employees had no role in the research, and research staff had no role in the interlock business. New analyses reported here complement and extend preliminary results previously published (Marques, et al., 2010b). Key assessments included the Timeline Followback (TLFB), Alcohol Use Disorders Inventory (AUDIT), the Drinkers Inventory of Consequences (DRINC), and the DIS-C (Diagnostic Interview Schedule) for DSM-4 diagnoses of Alcohol Dependence and Alcohol Abuse.

Interlock data and biological markers

Interlock performance data were based on BAC tests during the mean 8 months of interlock program participation; the average driver contributed ≈ 2800 BAC tests. With minor exceptions, interlock BAC test data were available on all participants. Not all enrollees were willing to provide blood and other biological specimens.

12 different alcohol biomarkers, or analysis types, were measured at baseline or calculated from baseline data. Six of the alcohol biomarkers were indirect markers, the other six analyses were for direct markers. The latter include PEth measured by HPLC (high performance liquid chromatography) and a subset of those samples was also measured for PEth by LCMSMS (liquid chromatography tandem mass spectroscopy). Others include hair FAEE, urine EtG, urine EtS (ethyl sulfate), and hair EtG. Six blood source biomarkers (GGT, %CDT, PEth, AST, ALT, MCV) were available for 300 participating subjects at baseline (range 298-302). Another, gamma %CDT, was calculated as a log combination of GGT and %CDT, based on Finnish research in which gamma %CDT (γ%CDT)= [0.8 ln(GGT) + 1.3 ln(%CDT)]. Other markers, including hair EtG were added to the panel after the start of the study. 146 subjects provided hair for EtG measurement. Measurements were performed by colleagues in laboratories in the US, Germany, Luxembourg, and Sweden.

Statistical analyses

Sensitivity analyses of 4 categories of criterion variables were made by calculating *A’,* which represents the area under the ROC curve, ranges from 0.0 to 1.0, and summarizes sensitivity points at various specificities. Each point on the ROC curve measures a sensitivity level (on the y-axis) vs. 1-specificity (on the x-axis) that jointly produces the decision criterion as a predictor is varied. Using lower cutoff values of predictor variables results in greater sensitivity but less specificity; using higher cutoff thresholds provides greater specificity but less sensitivity.

A new fail rate variable is defined as a 5 level ordinal combination (*combo5*) of two types of BAC test failures: total fail rate and morning fail rate. *Combo5* reflects both overall fail rate and fails that specifically occur in the morning hours of 6-10 AM (Monday through Friday and 8 AM-12 noon Saturday and Sunday) that reflect prior night drinking. The maximal BAC levels (*maxbac*) recorded on the interlock device during the first 2 program months is analyzed as dichotomous splits; the *A'* values represent 5 different comparisons with increasingly higher fail maxima (BAC results above and below .05, .06, .08, .10, and .12 g/dL). These cutoffs begin as a contrast between the 67% with BAC maxima below .05 and the 33% of participants with maxima of .05 g/dL and above. The series ranges up toward a comparison of the 95% below and the top risk 5% subset with BAC maxima of .12 g/dL and above.

Also included in the ROC analyses are two dichotomous variables: new DUI events (*recidivism*) that occur after beginning the interlock study program, and program entry DSM-IV diagnoses of alcohol dependence (*DSM dependence*). 36 new DUI recidivist events among 34 participants were logged after interlock installation at a mean of 798 days, about 26 months after program entry (median 775 days, range 177-1563 days). Whether or not there was a new DUI, the duration of time following interlock installation ranged from 344 to 1602 days of data. Participant intakes proceeded continuously over 4 project years. 39% of the sample met criteria for alcohol dependence.

Results

The point estimates of recidivism prediction by 8 alcohol biomarkers along with pre-program prior DUI and three sensitive indicators from the TLFB interview are shown in Figure 1. Hair EtG was a substantially more sensitive predictor of recidivism (*A'*=.7) than other test variables.

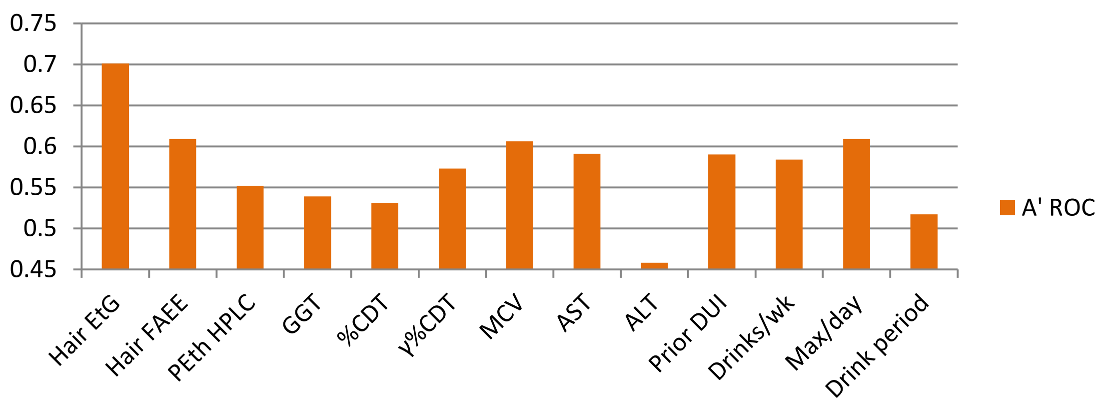

Figure 1: Sensitivity (A') of predictors of post-installation recidivism

Alcohol dependence is a valid alcohol risk factor. Figure 2 shows the point estimates associated with detection of an alcohol dependence diagnosis from the DSM-4 with all 12 biomarkers and other predictor variables. Here hEtG along with, uEtS and the TLFB measure, maximal drinks per drinking day, were all associated with entry dependence diagnoses (*A'*=.67). However, since drinking level (max drinks) influences the dependence diagnosis, the self-report and the diagnosis are not independent. The LCMSMS PEth in Figure 2 also shows high sensitivity.

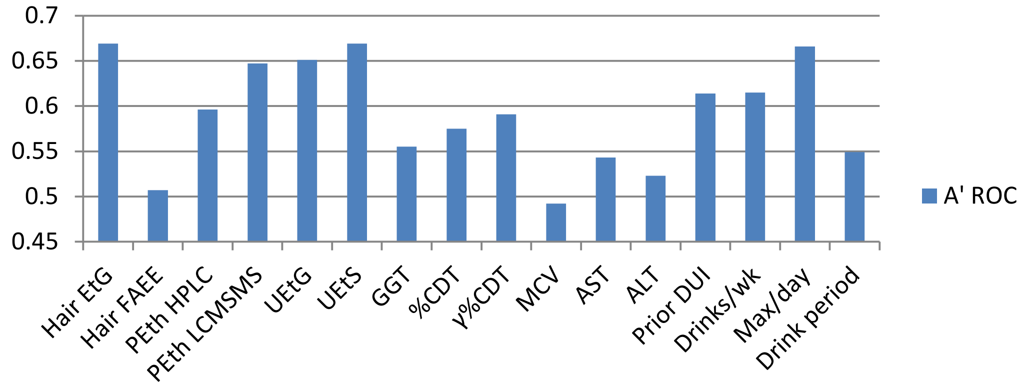

Figure 2: Sensitivity (A') of predictors of entry level of alcohol dependence

Figure 3 shows hEtG and PEth to be the most sensitive predictors of the highest BAC tests recorded during the first 2 months of interlock (*A'* >.69). The chart does not show sensitivity at the highest specificity, BAC≥ .12 g/dl. At that level, hair EtG had *A'*=.776, the highest found.

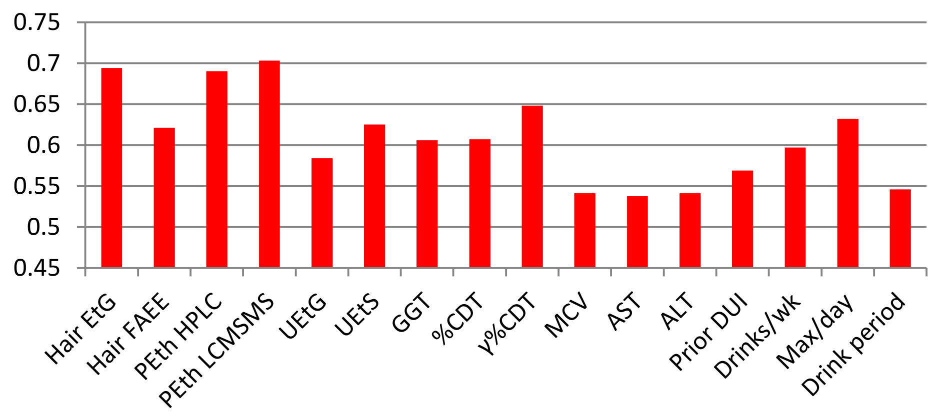

Figure 3: Sensitivity (A') of predictors of mean maximal BAC tests (average .05-.12 g/dl)

The sensitivity of the predictors of the combined fail rate criterion (*combo5*) is not shown but the results are concordant with those reported earlier. The fail rate measures were more successfully detected by PEth (either method: *A'*≥ .72) than hEtG (*A'*=.62). In that analysis, γ%CDT was also a sensitive indicator of the average of all BAC fail rates (*A'*=.71).

Hair EtG levels are not strongly correlated with other alcohol biomarkers. At a sample split of 30 pg/mg (the SOHT cutoff for heavy drinking) 2/3 of the drivers are above it. At 50 pg/mg, 1/3 of drivers exceed the split. The high hEtG subsets have many other risk indicators such as TLFB self-reported consumption, dependence, and interlock-based indicators of alcohol driving risk.

Discussion

Earlier, we showed PEth was the best overall biomarker for predicting interlock BAC test failure rate, the best correlate of 9 other concurrently measured biomarkers, and the best correlate of self-report assessments about alcohol consumption and consequences in the TLFB, AUDIT, and

DRINC. In the ROC analyses here, the levels of EtG in hair were found to be a top predictor of criterion variables including: future recidivism, DSM4 alcohol dependence, and maximal BAC attained during the initial two months with an interlock. The direct markers (PEth, EtG) yielded more sensitive and specific ways to predict driver alcohol risk variables than did the indirect markers. Also, the number of prior DUI convictions, ordinarily one of the strongest indicators of driver risk, underperformed nearly all of the alcohol biomarker variables for predicting recidivism, dependence, fail rates, or maximal BACs.

Since hair EtG is not strongly correlated with the blood or urine markers concurrently studied, but still predicts driver drinking behavior, it is a good component in a panel of markers; each panel element ideally contributes unique variance. These results and our prior analyses of alcohol biomarkers suggest both hair EtG and blood PEth warrant inclusion as core parts of any alcohol biomarker panel for DUI drivers. We also know that the highest risk DUI drivers have only somewhat lower biomarker levels than do non-residential alcohol treatment patients (Marques, 2012). Few laboratories measure total PEth. However, the detection of non-zero, low levels of PEth in blood via measurement of the dominant subtype of PEth via LCMSMS (Marques et al., 2011) may make possible more widespread use of this method to enhance road safety.

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Monitoring Road Safety with Alcohol Biomarkers: Types, Measurement, Interpretation, and Recommendations[1]

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Abstract

Context

Technologies for detecting alcohol use among drivers have advanced rapidly in recent years. Private sector businesses that supply alcohol monitoring products, such as portable breath testers, ignition interlocks or transdermal monitoring bracelets, are motivated to educate government authorities about their wares. The authorities may know about some alcohol biomarkers GGT, AST, MCV, ALT or CDT, but less often about PEth, EtG (hair or urine), or FAEE (hair), all of which have been studied as decision aides in forensic situations. There is no sole outside supplier of alcohol biomarkers measurements. Most test availability and biomarker measurement expertise germane to road safety is dispersed throughout academic research communities.

Objective

The objective is to conduct a preliminary assessment of prospective end users of this information. Recommendations are warranted for those interested in collection of bodily specimens (hair, blood or urine) for the purpose of estimating exposure to alcohol by using biomarkers. There is still no central information clearinghouse for helping with driver-related monitoring decisions. This pilot project distinguishes markers by consumption levels reflecting "excessive" alcohol use using published evidence and cutoffs that can support decisions. These initial recommendations will be revised with more input.

Outcomes

Information and classifications include: test availability, estimated costs, specimen types, direct or indirect markers, surveillance windows, sensitivity, and specificity for detecting alcohol consumption in the past days to past months. Evidential bases are from DUI populations, clinical populations, self-report assessments, diagnostic assessments, and interlock or driver data.

Discussion and Conclusions

While several nations have long used alcohol biomarkers to support driver fitness decisions, it is still uncommon in North America. This study provides a set of reference materials for those with responsibilities for making judgments about driver fitness and might want a primer on the types, virtues and liabilities of alcohol biomarkers.

Background

Brief Overview of Alcohol Markers

Medical research distinguishes state and trait alcohol biomarkers. *Trait markers,* indicators of alcoholism susceptibility, *are not* the subject of this project. Here, alcohol biomarkers refer

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exclusively to the chronic or acute biological indicators of alcohol use: *State markers*. Published research on alcohol biomarkers derive from two main sources: the biochemists and toxicologists, who develop and improve these measurement methodologies, and the clinical alcoholism researchers who use alcohol biomarker measurements as adjunctive decision aides for evaluating excessive use, dependence, or abstinence among patients under their medical care. Beyond the biomedical literature, studies are also coming from the forensic sciences and criminal justice professionals who use alcohol biomarker results as decision criteria. The extra-clinical exploitation of alcohol markers migrating into safety science is still in an early stage. More developments will follow more usage and will yield more outcome data. Recommendations can nonetheless be made for estimating driver exposure to alcohol by using biomarkers.

Direct or Indirect Alcohol Biomarkers

Alcohol biomarkers can be *indirect* or *direct* indicators of drinking. They can be *indirectly* elevated because of the way the bodies respond to chronic, toxic or repeated exposure to alcohol, or markers can be *directly* elevated because of an acute response to alcohol exposure.

Selecting the best marker or panel of markers depends on the questions to be answered. For example, it is possible with high accuracy to mark the cutoff levels of most consumption (direct) biomarkers that denote alcohol abstinence, (or at least levels that denote low or non-problematic drinking levels). But beyond non-drinking drivers, the problem of discriminating normal/modal social levels of drinking from excessive consumption is more nuanced. How can we distinguish consumption levels thought to reflect excessive alcohol use or levels of drinking that are potentially hazardous to the driving public? Recognized published cutoffs from clinical science can support those decisions. Questions about drinking in the past day or two will require a different marker than questions about a pattern of drinking in the past week, month, or months. In all cases, the information will be more dependable than self-reported consumption.

Indirect alcohol markers were the first type studied forensically. These are most often used as possible indicators of alcohol disease to aid in the diagnosis of alcohol dependence, alcoholism, or relapse. Five indirect markers are most widely used. The first three, shown below, are insensitive, non-specific, or both. The last two are more informative. Indirect markers include:

- alanine aminotransferase (ALT), a liver enzyme measured in blood serum,
- aspartate aminotransferase (AST), a liver enzyme measured in blood serum,
- macrocytic volume (MCV), an estimate of the size (volume) of red blood cells,
- gamma glutamyltransferase (GGT), a liver enzyme measured in blood serum,
- carbohydrate deficient transferrin (CDT), an abnormal form of an iron transport protein measured in blood serum
- Other indirect markers are under active study and include, among others: 5-hydroxytryptophol, sialic acid index of plasma apolipoprotein J, beta hexosaminidase.

Commercial CDT measurement is widely available in most nations. GGT is the best of the liver enzyme markers with a sensitivity approaching CDT, but CDT elevation is more specific to alcohol than is a rise in GGT. None of the indirect markers have been found sensitive to episodic heavy drinking (SAMHSA, 2012) and are more attuned to heavy chronic drinking.

Direct alcohol markers directly reflect alcohol consumption and are usually products of alternative ethanol metabolic pathways that persist in circulation longer than ethanol or its metabolites. These are formed only in the presence of ethanol. The major direct markers with a good body of research that have also been studied for forensic purposes include:

- ethanol itself,
- ethylglucuronide (EtG), a minor metabolite of ethanol most commonly measured in urine, but can also be retrieved from blood, hair and oral fluid,
- ethyl sulfate (EtS) like EtG but with a slightly shorter half-life,
- phosphatidylethanol (PEth), an abnormal cell membrane phospholipid produced in the presence of ethanol. PEth occurs readily because a common enzyme, phospholipase D,
- fatty acid ethyl esters (FAEE), formed by condensing alcohol and an acid.

PEth and EtG are the most studied direct markers. In acute dosing, blood PEth zeroes out in a week, but very heavy drinkers' levels take weeks of abstinence to reach zero (Wurst et al., 2012). However with significant acute dosing PEth elevates gradually and upon cessation of drinking has a half-life of about a week (Viel et al., 2012). Regular heavy drinkers have detectable PEth. EtG and FAEE can be measured in urine, blood, or hair. In urine, EtG extends detection of ethanol use by one to two days. In hair, the alcohol/EtG detection window is months as EtG is sequestered in the growing hair shaft. In hair samples, EtG or FAEE provide long term exposure indicators, and the only objective alternatives to confessional estimates of historical alcohol use.

Current Uses in Road Safety Decision Making

In addition to their clinical uses, licensing authorities in several nations, measure the liver enzymes GGT, CDT, AST and ALT, and MCV as part of a biomarker panel to aid in decisions about driver license restitution for DUI driving. AST, ALT and MCV are too insensitive to detect binge drinkers or the high end of normal, especially among youth who represent a significant portion of alcohol road risk.

While not specific to alcohol, GGT is often elevated after chronic alcohol consumption. It was one of the earliest used and is still presently a useful marker, receiving considerable study among driver license applicants in the Netherlands, Sweden, Switzerland, and Norway, to name a few. GGT is best used in combination with other markers since it is affected by diseases that may be unrelated to alcohol use (e.g. biliary or hepatic diseases). CDT is a specific indicator of high levels of alcohol use. The carbohydrate deficiency of transferrin occurs because the iron transport protein loses some of its carbohydrate containing sialic acid end groups as a result of regular ethanol exposure. It is not clear why ethanol does this, but the amount of carbohydrate deficiency strongly reflects the degree of ethanol exposure. Transferrin becomes more deficient after regular consumption of about 60 g ethanol per day (about 5 standard drinks). The relative percent of carbohydrate deficiency (%CDT) reflects the growth of these deficient isoforms relative to the total CDT found in an individual, and today %CDT, not total CDT, is the recommended method for reporting. The percent of total deficiency improves the value of the marker by overcoming some age and gender-related variation in total transferrin. In the past few years, toxicology researchers who study CDT have focused on the "disialo" isoforms of %CDT. Targeting these more specifically deficient isoforms has caused some change in the recommended cutoff levels for heavy drinking from 2.6% to about 1.8% of total. The type of %CDT under study should be noted to understand the reported levels.

GGT and CDT levels can be combined. Berner et al., (2006) in a large German study of drivers found distinct advantages to combining the GGT and %CDT markers to improve sensitivity, especially for women. Marques et al., (2011) found the combined marker, γ%CDT, had better accuracy for detecting the highest risk group in an interlock DUI population (based on failed BAC tests) than did either marker alone.

The *direct markers* are more sensitive and more specific. Road safety studies with EtG, PEth, and FAEE are now widely available. EtG measured in urine and hair, are the primary biomarkers now in Germany for assessing drinking prior to making driver fitness judgments. In urine, EtG and EtS, can be measured for about 1-1½ days after blood ethanol goes to zero. External exposure slightly raises urine EtG, but above 500 ng/ml precludes most incidental exposure.

Pirro et al. (2011) in a comparative detection study recently characterized hair EtG (hEtG) as the most accurate biomarker for the identification of chronic alcohol misuse relative to known heavy drinking. For assessing drinking drivers, Liniger et al. (2010) found hEtG to be the best choice for assessing fitness. The Society of Hair Testing regards 30 picograms of EtG per mg of hair as the best cutoff for excessive drinking. Dufaux et al. (2012) analyzed samples from German drivers seeking to reinstate license status and found that the use of EtG in hair, with its longer time horizon, detected 12.7% positives relative to 2.1% positives found with the measurement of EtG in urine. These are stable findings based on sample sizes of 4000 and 13,000 respectively.

Marques et al., (2010) reported PEth to be the one alcohol marker among 9 others to have the strongest correlation with other markers, the largest F ratio predicting 3 risk groups of drivers based on failed interlock BAC testes, and showed the strongest relationship with psychometric assessments. Viel et al., (2012) reviewed PEth studies and reported that social drinkers' PEth is either undetectable or below 1 µmol/l. With PEth levels between social drinkers and dependent alcoholics, Marques et al., (2010) reported that the 20% highest risk subset of ignition interlock users (based on rates of failed BAC tests) averaged 1.5 µmol/l and over 5.0 at the highest level. Most PEth studies in the literature have used the HPLC ELSD (high performance liquid chromatography with an evaporative light scattering detector) methods developed by the Lund University Neurochemistry Department in Sweden. The Swedish lab uses 0.7 µmol/l as the limit of quantitation (LOQ). There is no international consensus cutoff of PEth that differentiates social use and problematic use. Many labs use PEth levels above the LOQ up to 1µmol/l. In addition to measuring total PEth, newer LCMSMS (tandem mass spectrometry) methods can detect a molecular subspecies of PEth (16.0/18/1) that has been referred to as POPE ((1-palmitoyl-2-oleoyl-*sn*-glycero-3-phosphoethanol) and represents about 45% of the total PEth. Several studies with POPE have found it to be more sensitive than total PEth at detecting low levels of drinking. With drivers, Marques et al., (2011) found that POPE was detected in lower risk DUI offenders for whom full PEth was essentially zero (<.22 µmol/l).

This review has been made available to a sample of hospital researchers, DUI experts, judges and licensing authorities. The purpose has been to evaluate its usefulness, make adjustments where warranted, and revise. Table 1 will be modified as more recommendations are received.

Discussion and Recommendations

Following DUI charges, most alcohol offenders participate in some form of intervention to reduce public risk exposure, whether treatment, education, interlock or any combination of those.

None of those interventions can provide definitive information about a driver's continued proclivity toward alcohol use. However effective a DUI intervention initially – such as interlock – most studies find a full return to control levels of recidivism after interlock removal. These observations suggests the need for better knowledge about alcohol consumption levels prior to relicensing, even if the offender has already fulfilled a government requirement that seeks to control or rehabilitate the individual. A balanced approach to recommending alcohol biomarkers for road safety applications would combine the most widely used indirect alcohol biomarkers, CDT and GGT, with key direct markers anchoring the panel to document drinking within a more specifiable timeframe. The latter include hEtG, PEth, and uEtG respectively, for longer, midrange, and shorter duration measures of drinking in the recent past.

There is a tradeoff between state of the art and availability of laboratories that can make these measurements. Table 1 reviews test availability, marker type, duration, and evidence of sensitivity, specificity in detecting alcohol consumption. Estimates about practical availability of tests and laboratories will vary regionally but a rough estimate is proposed. Tabled classification criteria are based on published evidence from: DUI populations, clinical populations, self-report assessments, diagnostic assessments, and interlock or driver data.

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Table 1: Aspects of Alcohol Biomarkers for Use in Monitoring DUI Drivers

Marker[2]	Detect Heavy Drinking	Monitor Abstinence[3]	Detect Past Drinking	Time to zero out after max	Sens.[4]	Spec.	Methods	Availability Analysis[5]	Comment	Road Research Studies
GGT	often	no	weeks	2-4 wks	med	low	common many	high	liver diseases alter, but much safety research	yes
MCV	sometimes	no	month+	n/a	low	med	direct obs.	high	clinically useful	yes
%CDT[6]	yes	no	weeks	2-3 wks	med	med	[7]	medium	best studied in road safety	yes
PEth whole blood	yes	somewhat	weeks	2-4 wks	med	high	[8]	low	special sample handling [9]	yes
PEth-POPE[10] whole blood	yes	better than whole PEth	weeks	2-4 wks	high	high	LCMSMS	medium	still new, need more studies	yes
EtG – urine (EtS – urine)	recent only	yes	2 days	1-3 days	high	high	LCMSMS	medium to high	levels <500 ng/ml EtG poss. passive exposure	yes
EtG – hair	yes	long term only	1-9 mos.	3 cm= 3 mos.	high	high	LCMSMS	low	best for extended term alcohol use proclivity	yes
EtG, EtS oral fluid	recent only	not very practical	1 day	hours	high	high	LCMSMS	low	not so useful (short half-life)	?
FAEE - hair	yes	long term only	1-9 mos.	3cm = 3 mos.	high	high	LCMSMS	low	good alternative if hEtG not available	yes
FAEE - blood	yes	yes	2 days	hours	high	high	LCMSMS	low	not so useful (short half-life)	yes

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2 AST and ALT are not included since both sensitivity and specificity are too poor to recommend.
3 Implies good sensitivity, specificity and prompt elevation
4 Sensitivity of direct markers vary with source, but in general are very high; when from urine, blood or oral fluid they reflect recent consumption of alcohol. A marker sensitive for consumption may not be as useful as an alcohol disease/dependence/alcoholism indicator.
5 Measurement services are regionally availability and will differ – the estimate provided is general and approximate.
6 Percent disialo CDT is now becoming more widely used as the best isoform of %CDT to denote alcohol use. The expression of a % level of disialo CDT relative to total transferrin standardizes it by adjusting relative to total CDT levels.
7 Immunoassay, HPLC, capillary electrophoresis, others
8 Many: thin layer chromatography, HPLC with evaporative light scattering detector, gas chromatography, electrophoresis, immunoassay
9 Lund University Neurochemistry's pioneered HPLC procedure with ELSD requires collection of whole heparinized blood in plastic tubes then transfer to glass for ultracold -80C storage.
10 POPE (1-palmitoyl-2-oleoyl-*sn*-glycero-3-phosphoethanol), also shown as PEth 16.0/18.1, is reportedly the most prevalent molecular species of phosphatidylethanol (PEth). It represents about 45% of PEth on a molar basis. Sample handling is similar to whole PEth.

Cannabis and Alcohol: Is there a relationship for drivers?

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Background: The 2007 National Roadside Survey identified cannabis as the most frequently identified drug found in the drivers, and of those individuals who entered Texas publicly-funded programs with at least one past-year DUI, 66% (22,666) had a primary problem with alcohol and 13% (4,438) had a primary problem with cannabis.

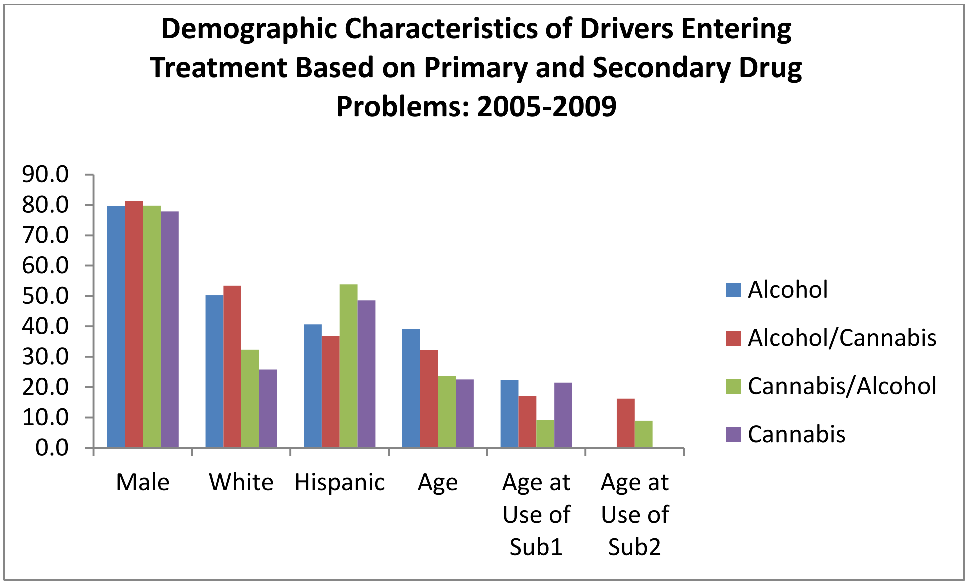
Aim: To examine the characteristics of these drivers at treatment admission who were primarily cannabis users as compared to those using cannabis and alcohol and those with a primary problem with alcohol.

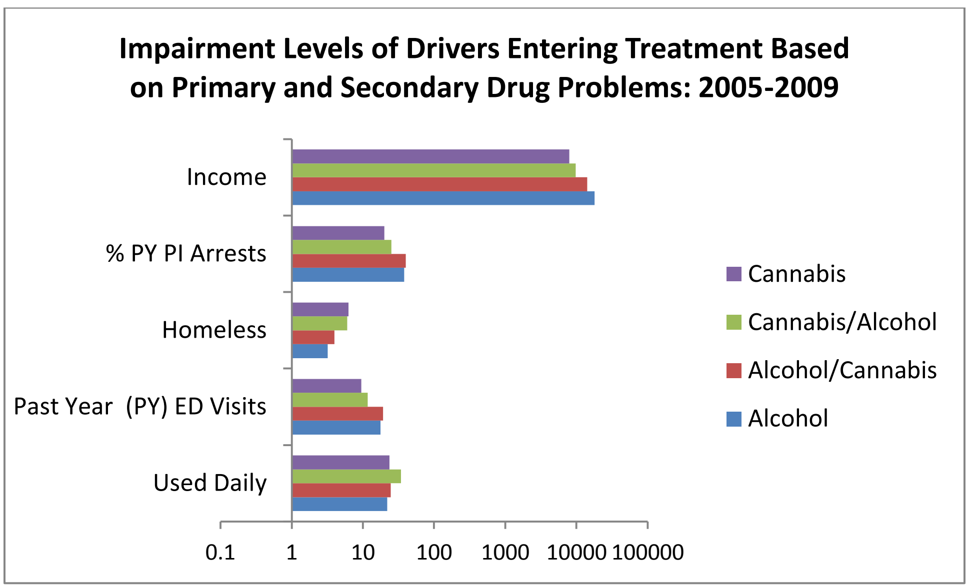
Methods: A database of 56,717 treatment admissions of DUI drivers was examined using correlation and significance tests to determine differences in these individuals and to assess their risks for abstinence after completing treatment. Analysis was performed in SAS Version 9.2. All findings were significant at at $p<.0001$.

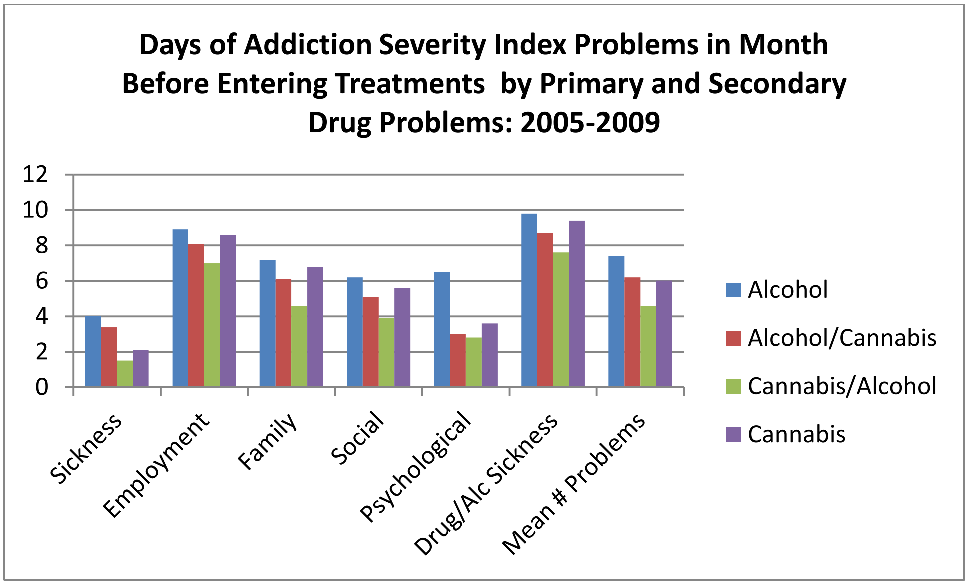
Results: Individuals with a problem with cannabis but no alcohol problems were younger had used their primary drug fewer years, were less likely to complete treatment, had lower income, had fewer substance abuse problems, and were more likely to be homeless, as well as more likely to be Hispanic.

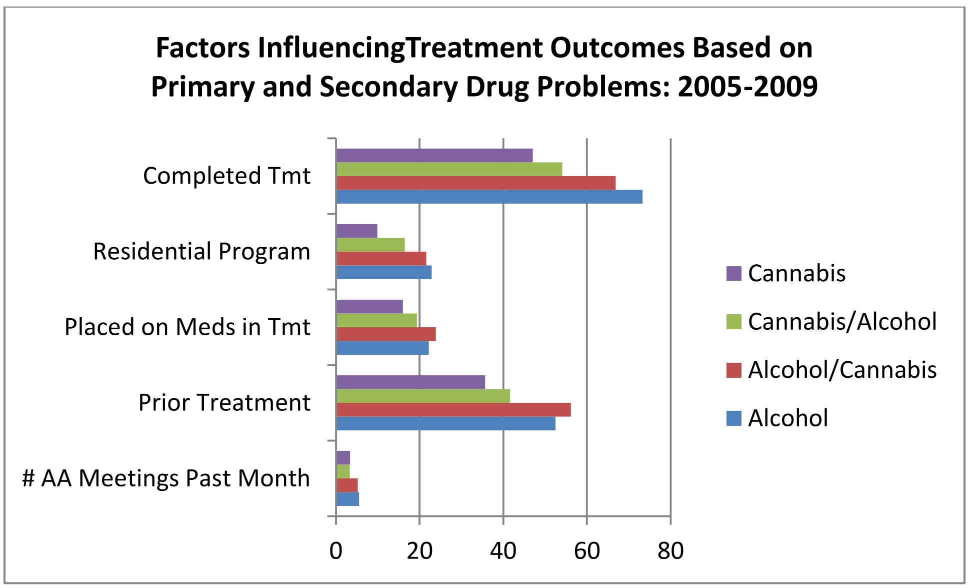
Those who only had problems with alcohol were older, had been in treatment more times, had used more years, had more severe levels of impairment, but completed treatment and had higher incomes. Between these two extremes were those who had primary problems with cannabis and secondary with alcohol and those who had primary problems with alcohol and secondary with cannabis. As their problems with alcohol grew and problems with cannabis decreased, their severity increased in terms of ASI problems, employment, need for medications, emergency room visits, and non-DUI arrests.

Conclusions: Impaired drivers who first develop problems with cannabis appear to move along a continuum that includes adding alcohol as the second problem, then developing more problems with alcohol and less with cannabis, and finally having serious problems with alcohol. Use of these two drugs in various combinations of intensity is a factor that should be addressed during the individual's drug using career with appropriate sanctions targeted to the combination of drugs to lessen driving under the influence.


Demographic Characteristics of Drivers Entering Treatment Based on Primary and Secondary Drug Problems: 2005-2009
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Male
White
Hispanic
Age
Age at Use of Sub1
Age at Use of Sub2
Alcohol
Alcohol/Cannabis
Cannabis/Alcohol
Cannabis


Impairment Levels of Drivers Entering Treatment Based on Primary and Secondary Drug Problems: 2005-2009
Income
% PY PI Arrests
Homeless
Past Year (PY) ED Visits
Used Daily
0.1
1
10
100
1000
10000
100000
Cannabis
Cannabis/Alcohol
Alcohol/Cannabis
Alcohol





Data tables will be included on the poster.

Substance Abuse Treatment and Impaired Drivers

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Background: Screening and assessment of impaired drivers is critical to lessen their chances of recidivism. Offenders vary on a range of socio-demographic characteristics, including age, traffic and non-traffic offences, and they may use multiple drugs, as well as alcohol, and be abusers or dependent on alcohol and drugs. Further, addiction or substance dependence is a disease of relapse. Success can be measured by the length of abstinence or longer periods between the occurrences of substance use or impaired driving incidents. In order to combat impaired driving, there are a number of tools and sanctions currently available. These include screening, assessment, brief interventions, DUI/DWI education courses, and drug and alcohol treatment, as well as alcohol monitoring technologies, probation, and incarceration.

Aim: To examine the characteristics of these drivers at treatment admission and to identify the sources which refer impaired drivers to treatment and to determine differences in offenders based on referral source.

Methods: The database of 45,045 Texas treatment admissions of DUI drivers was examined using correlation and significance tests to determine differences in these individuals. Analysis was performed in SAS Version 9.2. All findings were significant at at $p<.0001$.

Results: There were important differences among these drivers based on their source of referral and their socio-demographic characteristics. Those referred from DUI/DWI probation were the least likely to be female, had fewer prior treatment admissions, were among the oldest, reported more months of employment and had fewer problems than those referred from other sources. Those who were self-referred were the oldest, most likely to be female, had more previous treatment admissions, had been using the longest, and reported more problems in the last 30 days.

Different referral sources tended to handle offenders with different alcohol and drug problems. DUI/DWI probationers were most likely to have a primary problem with alcohol or sedatives such as benzodiazepines, while those with primary problems with cannabis were the most likely to be referred by other law enforcement agencies. Those with problems with methamphetamine or powder cocaine were the most likely to come from non-DUI/DWI probation departments and those with problems with heroin, other opiates or crack cocaine tended to refer themselves to treatment.

The socio-demographic characteristics of the impaired drivers also varied by the primary substance of abuse. The offenders with a primary problem with alcohol were the oldest and the least likely to have a second problem with another drug. Those with a primary problem with cannabis were the youngest, male, and reported fewest problem days as measured on the

Addiction Severity Index. Those with primary problems with heroin or other opiates were the most impaired, reporting more days of ASI Index problems in the last 30 days and more likely to report daily use. Users of opiates and sedative tended to prefer "downer" drugs as their second drug of abuse. The offenders with a primary problem with powder cocaine were the least likely to report daily use. The offenders with a primary problem with crack cocaine were the oldest, and 45% had a secondary problem with alcohol. Those with problems with methamphetamine were among the most likely to report problems with other drugs. Overall, alcohol as a secondary problem varied by drug, with nearly half of those using powder cocaine or marijuana also having a problem with alcohol, while less than 20 percent of those using heroin or other opiates reported a secondary problem with alcohol.

Conclusions:

The majority of DUI/DWI referrals to Texas treatment between 2005 and 2009 were from the criminal justice system, but many of the offenders were not on DUI/DWI probation but came from other referral sources. In addition, many of the offenders were poly-substance abusers, who can pose significant treatment challenges. Oral fluid tests should be routinely administered to all persons suspected of a DUI/DWI, and followed by a blood or urine test if drugs are found by the oral test.

In-depth screening and assessment using instruments which query about use of alcohol and drugs and toxicology results should be used for all individuals arrested for DUI/DWI to identify the extent of their substance use. A DUI/DWI arrest is a good predictor of further potential alcohol and drug use problems, as well as other anti-social or offending behaviors, and a first arrest offers an opportunity to intervene with substance users through treatment before their conditions become more severe and and additional driving infractions occur.

Treatment is a long-term and ongoing process that begins with intensive services and eventually tapers off into regular 12-step meetings. Treatment can encompass a range of interventions at various levels of care, including medication-assisted therapies and treatment for mental health issues.

Additional monitoring of drug use, as well as alcohol use, during and after treatment is recommended. Ultimately, abstinence and recidivism outcomes can be lessened with close coordination between treatment and probation. Communication between these parties can facilitate monitoring and lead to improved supervision and treatment plans through the sharing of information.

Trends in alcohol-impaired driving in Canada

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Abstract

Background
Drinking and driving continues to be a major road safety problem in Canada with 744 persons killed in crashes involving a drinking driver and 37% of fatally injured drivers testing positive for alcohol in 2010, the most recent data year available.

Aims
This paper describes recent trends in drinking and driving in Canada to better understand the current situation, and to determine whether the magnitude of the problem has been increasing or decreasing.

Methods
Multiple indicators are used to examine trends in drinking driving behaviour and alcohol-related fatalities. Data sources include: A National Fatality Database, a comprehensive source of national data compiled annually by the Traffic Injury Research Foundation (TIRF) from coroner/medical examiner files and police reports on fatal crashes; and the Road Safety Monitor (RSM), an annual National Public Opinion Poll on Drinking and Driving conducted by TIRF.

Results
From 1995 to 2010 in Canada, there has been a continued and fairly consistent decrease in the number of fatalities involving a drinking driver in absolute terms as well as when these numbers are standardized into per capita and per licensed driver rates. The number and percent of fatally injured drivers testing positive for alcohol have also declined over this study period. Survey data from the RSM further show that the percentage of those who reported driving after they thought they were over the legal limit has also decreased consistently and significantly since 2008.

Discussion and conclusions
Despite the apparent decreasing trend in drinking driving fatalities and behaviour since 1995, reductions have been relatively modest in recent years, and fatalities in crashes involving drivers who have consumed alcohol remain at high unacceptable levels.

Introduction

Previous research has demonstrated that the magnitude of the alcohol-fatal crash problem in Canada declined in the 1980s and again in the 1990s (Brown et al. 2012; Mayhew 2010; Vanlaar et al. 2012). However, the decrease in the drinking and driving problem was less pronounced in the 1990s. To better understand recent trends, this paper examines changes in the drinking and driving problem using a variety of indicators such as the number and proportion of persons killed in crashes involving drinking drivers, the percentage of fatally injured drivers testing positive for alcohol, and self-reported drinking and driving behaviour.

Method

Data on alcohol use in fatal crashes were obtained from the National Fatality Database which is developed and maintained by TIRF. This National Fatality Database until recently was jointly funded by the Canadian Council of Motor Transport Administrators (CCMTA) and Transport Canada. The Fatality Database provides a comprehensive source of objective data on alcohol use among fatally injured persons in Canada – over 80% of fatally injured drivers in Canada are tested for the presence of alcohol each year. These data are compiled using two sources of information: (1) police reports on fatal motor vehicle collisions and (2) coroners' and medical examiners' reports, which contain the blood alcohol concentration results (see TIRF 2013).

The number of persons killed in a traffic crash involving a drinking driver reported in this paper is based on alcohol-related fatalities occurring on public roadways involving at least one principal vehicle type (automobile, truck/van, motorcycle, or tractor-trailer). A motor vehicle fatality is defined as any person dying within 12 months as a result of injuries sustained in a collision involving a motor vehicle. Drinking drivers who were killed are also included among the fatalities

Self-reported drinking and driving behaviour from 1998 to 2012 is derived from the Road Safety Monitor (RSM), an annual public opinion survey developed by TIRF to take the pulse of the nation on key road safety issues. The RSM includes a core set of questions, notably on drinking and driving that are asked each year to provide information on trends in attitudes, opinions and behaviours. A total of 903 Canadians completed the poll in 2012 (TIRF 2012). Results can be considered accurate within plus or minus 3.3%, 19 times out of 20.

Results

The Number and Percentage of Canadians Who Die in Traffic Crashes Involving a Drinking Driver

As shown in Figure 1, in 2010, 744 Canadians were killed in a traffic crash involving a drinking driver. This is a slight increase compared to 2009 when there were 714 drinking driving fatalities. With the exception of 2010, this represents a continued and consistent decrease since 2006 and is below the 2004 number (815), the lowest count from 1995 through 2008. It appears a decreasing trend in fatalities may be emerging in recent years, which will have to be further monitored given the slight increase in the numbers in 2010.

Figure 1 also shows the annual percentage of persons killed in a traffic crash in Canada involving a drinking driver. In 2010, of all persons fatally injured in a motor vehicle crash, 34% involved a drinking driver. As can be seen, this percentage has decreased from a high of almost 40% in 1995 and has been fairly consistent since 1999 remaining around 30%.

A similar pattern emerges in Figure 2 when controlling for overall population changes by examining: the number of persons killed in a traffic crash involving a drinking driver per 100,000 population aged 16 and over; and the number of persons killed in a traffic crash involving a drinking driver per 100,000 licensed drivers. As can be seen, there has been a fairly consistent decline in both per-capita and per-driver rates over this study period.

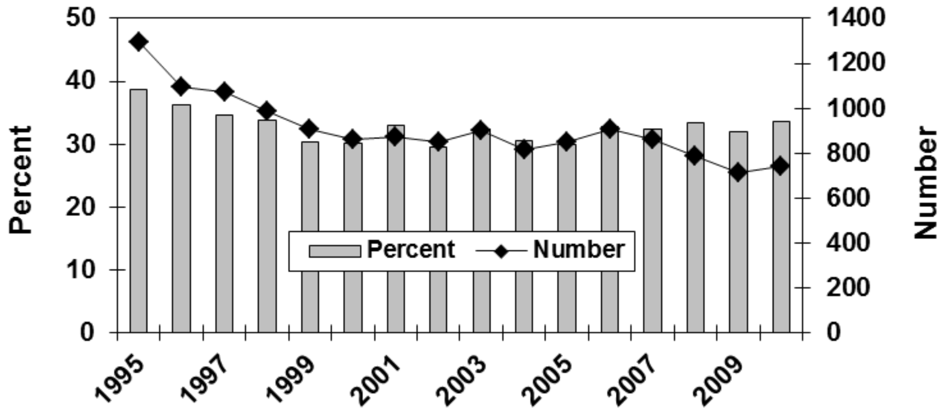

Fig. 1:Number and percent of deaths involving a drinking driver: Canada, 1995-2010

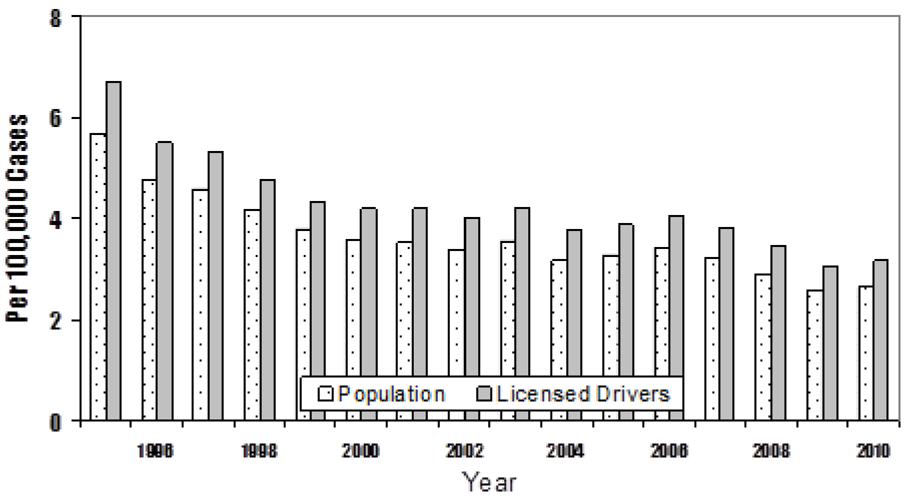

Fig. 2: Number of deaths involving a drinking driver per 100,000 persons aged 16+ and licensed drivers: Canada, 1995-2010

The Number and Percentage of Fatally Injured Drivers with Positive BACs in Canada
Figure 3 show the numbers of non-drinking and drinking fatally injured drivers and the percentage of these drivers who were positive for alcohol. As can be seen, both the numbers of non-drinking and drinking fatally injured drivers have declined since about 2005. As a consequence of the declines in both these groups, the annual percentage of fatally injured drivers who tested positive for alcohol has remained in the range of 36-39%. From 2008 (39%) to 2010 (37%), however, there has been a slight decline in this indicator, which is suggestive of a new downward trend that needs to be monitored and confirmed over the next few years as data become available.

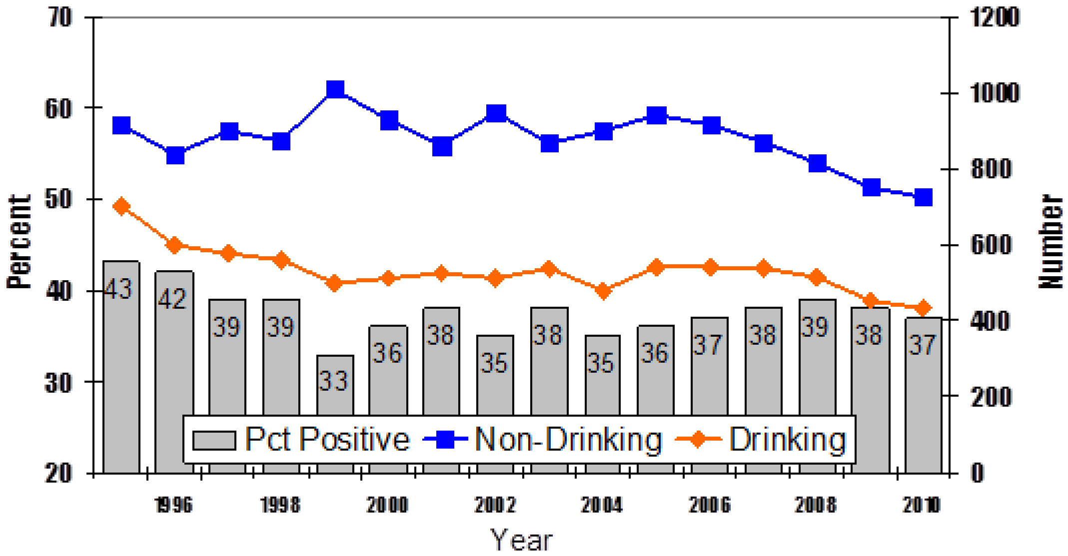

Fig. 3: Number of non-drinking and drinking fatally injured drivers and percent positive for alcohol: Canada, 1995-2010

A comparison of the percentage of fatally injured drivers positive for alcohol in Canada and the United States from 1995 to 2010 is provided in Figure 4. Both countries have seen comparable reductions in the percentage of fatally injured drinking drivers during the early and more recent part of this study period. From 2004 to 2010, the percentage of fatally injured drivers with positive BACs in Canada and the United States has been almost identical.

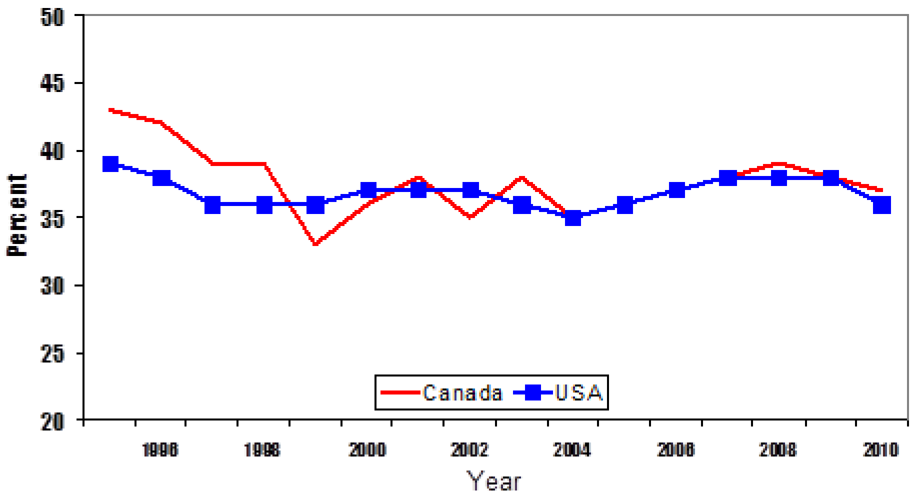

Fig. 4: Percent of fatally injured drivers with positive BACs in Canada and United States: 1995-2010

The Percentage of Self-reported Impaired Drivers

The above trend analyses focused on trends in indicators of the consequences of drinking and driving (i.e., drinking driving fatalities) and not indicators of the prevalence of this behaviour. In the RSM, when asked about driving when they thought they were over the legal limit in the past 12 months, 3.6% of Canadians admitted to doing this in 2012 (see Figure 5). This represents a significant decrease compared to 2011 when the percentage was 5.4%. Of importance, the percentages from 2008 to 2012 do appear to confirm the considerable drop from 8.2% in 2007 to 5.2% in 2008. Reasons explaining the additional decrease in 2012 to 3.6% are not immediately apparent but this finding is encouraging. It suggests that drinking driving fatalities in 2011 and 2012 may also further decrease. Further monitoring is needed.

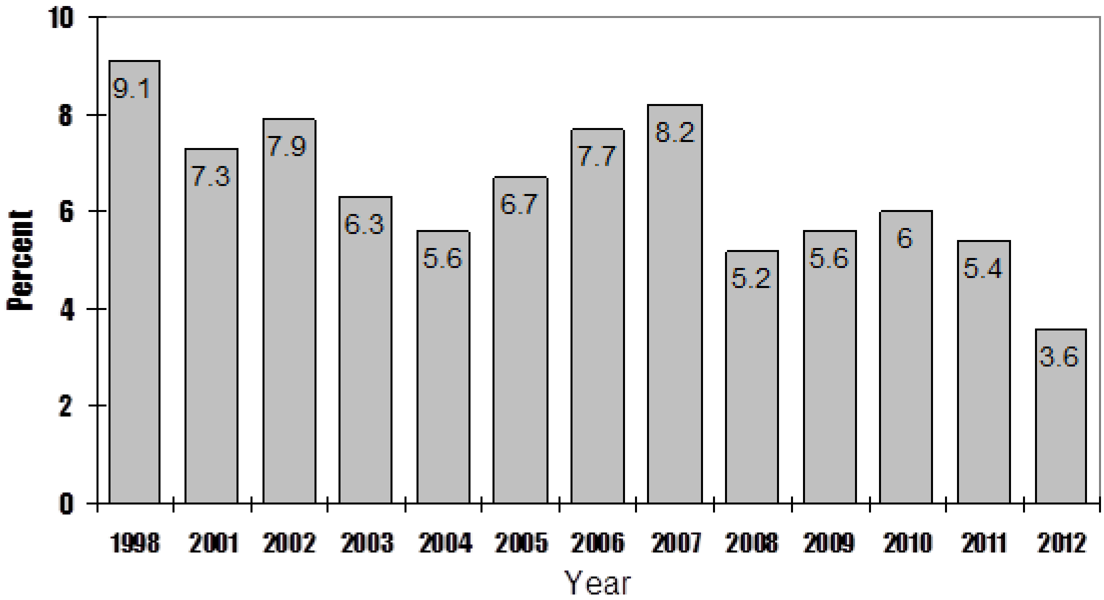

Fig. 5: Percentage of respondents who reported driving while over the legal limit for alcohol: Canada, 1998-2012 (based on Road Safety Monitor)

Conclusion

There has been a continued and consistent decrease in the number of fatalities involving a drinking driver in Canada dropping to 714 in 2009, albeit increasing only slightly to 744 in 2010. A similar pattern is apparent when looking at the number of persons killed in a traffic crash in Canada involving a drinking driver per 100,000 population and per 100,000 licensed drivers. As well, the number of drinking fatally injured drivers has declined and there is some suggestion that the percentage of fatally injured drivers with positive BACs has also decreased slightly in recent years. A similar trend to Canada in the percentage of fatally injured drinking driver is also apparent in the United States. Finally, the percentage of those reporting drinking and driving when they thought they were over the legal limit has also decreased consistently and significantly since 2008.

More data are needed to further monitor these trends and to confirm whether the situation is indeed improving or not, especially in light of the slight increase in the number of fatalities involving a drinking driver from 2009 to 2010. Finally, regardless of an apparent decreasing trend in these indicators of the drinking and driving problem, fatalities in which drivers have consumed alcohol remain high at unacceptable levels in Canada. This also speaks to the need for further research to better understand the reasons for changes in alcohol-impaired driving that will provide insights into more effectively addressing the problem.

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Effects of all-offender alcohol ignition interlock laws on recidivism and alcohol-related crashes

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Abstract

Background
Increasingly U.S. states mandate alcohol ignition interlock orders for all alcohol-impaired driving (DUI) convictions, but little research has examined their effects.

Aims
Examine effects on recidivism and alcohol-impaired crashes of Washington state's ignition interlock laws, including a 2004 extension of the interlock requirement to all first DUI convictions and a 2009 law allowing interlocks in lieu of administrative license suspension; examine multi-state effects of interlock laws on alcohol-related fatal crashes.

Methods
Washington trends in conviction types and interlock installations for first DUI convictions were examined. Linear regressions examined recidivism rates with either law changes or interlock installation rates as predictors and all DUI arrests to control for enforcement variation. To examine general deterrence effects, times series cross-section regression was used to compare Washington single-vehicle late-night crash trends to California and Oregon trends and to examine effects of states' interlock laws on alcohol-related fatal crash trends.

Results
After Washington's 2004 law change, the interlock installation rate among affected offenders was about one-third compared to about 3-6% in the prior year. The 2-year recidivism rate declined 12% among affected offenders; a 0.06 percentage point decrease in recidivism was associated with each percentage point increase in the interlock use rate. The law change was associated with an 8% reduction in single-vehicle late-night crash risk. The 2009 law change appears to be having the desired effect of increasing interlock installations and ensuring they occur more quickly after arrest. Multi-state analysis of alcohol-related fatal crashes is underway.

Discussion and conclusions
Washington's first-offender interlock laws were associated with reduced recidivism, even with low interlock use rates, and crash reductions. Additional gains may be achieved with higher interlock use rates, limiting reductions in DUI charges to other traffic offenses, and publicizing interlock laws.

Introduction

Alcohol-impaired driving (DUI) crash deaths fell sharply in the United States during the 1980s and early 1990s, but progress then stalled. In 2011, 31% of highway deaths occurred in crashes involving drivers with blood alcohol concentrations (BACs) of 0.08% or higher. Drivers with DUI convictions are overrepresented in fatal crashes (Fell, 1993) so that reducing recidivism potentially could lower deaths. A promising countermeasure is requiring alcohol ignition interlocks on convicted DUI offenders' vehicles. As of April 2013, 19 states require all drivers convicted of DUI to install interlocks in order to drive during a driver's license suspension and/or require interlocks for specified periods before full relicensure. In 23 states, such laws apply only to first offenders with high BACs (usually ≥0.15%) and/or repeat offenders.

Studies have found that offenders who install interlocks are less likely to recidivate than those who do not, but effects dissipate after interlock removal (Elder et al., 2011). Multiple offenders eligible for license reinstatement were randomly assigned to interlock-restricted licenses or to unrestricted licenses coupled with conventional treatment (Beck, Rauch, Baker, & Williams, 1999). Recidivism for the entire interlock group was 64% lower during the year following conviction, with 64% installing interlocks. The few studies examining the effects of interlock programs on offenders' crashes had mixed findings (e.g., Bjerre, 2005; DeYoung, Tashima, & Masten, 2004).

The current research extends prior research by examining the effects of a law extending an interlock requirement to all first-time DUI convictions on the entire cohort of affected offenders and the association between the interlock installation rate and the rate of recidivism (McCartt, Leaf, Farmer, & Eichelberger, 2013). The general deterrent effects of ignition interlock laws on alcohol-related crashes also are examined.

Effects of Washington state's interlock laws

Effective January 1, 1999, Washington courts were required to order interlocks, following conviction, for repeat offenders and for first offenders with "high BACs" (≥0.15%) or alcohol test refusals, including qualified offenders choosing the deferred prosecution track. In July 27, 2003, the issuance of interlock orders was moved from the courts to the Department of Licensing. Then, on June 10, 2004, the 1-year interlock order requirement was extended to first DUI convictions with BACs <0.15%, and offenders could reduce a 90-day pre-conviction, administrative license suspension by getting an interlock-restricted license after 30 days of the suspension. On January 1, 2009, the interlock program became available to offenders immediately after arrest, without the 30-day license suspension. This research examines effects of the 2003 and 2004 law changes and preliminary effects of the 2009 change.

Methods

Information on convictions resulting from DUI arrests was extracted in June 2012 from driver license record files. Trends in conviction types and interlock installations were examined for first alcohol-related convictions ["simple" (BAC <0.15%), high-BAC, and test refusal DUIs; deferred prosecution; and alcohol-related negligent driving] stemming from arrests during 1999-2009. A 7-year window was used to identify first offenses. Conviction types and interlock installations were tracked by quarter, indexed to date of arrest.

Trends in recidivism for up to 3 years after arrest were examined for first simple DUI and all first DUI convictions resulting from arrests during January 1999-June 2004. Linear regressions on recidivism rates were examined with the 2003 and 2004 law changes or the proportion of offenders who installed interlocks as predictors and all DUI arrests as a control for potential enforcement variation. The proportions of offenders in each arrest quarter who recidivated within 2 years were modeled as a function of three time trend variables (number of quarters since January 1999, number of quarters squared, number of quarters cubed), a count of all DUI arrests for the quarter, and indicator variables coded as 1 for arrests occurring during or after the third quarter of 2003 and as 1 for arrests occurring during or after the third quarter of 2004.

To examine general deterrent effects of the 2003 and 2004 law changes, time series cross-section regression compared trends in single-vehicle late-night (midnight-3 a.m.) crashes in

Washington during 2001-07 to trends in California and Oregon, nearby states without important changes in DUI laws during this period. The dependent variable was the logarithm of the seasonally adjusted percentage of single-vehicle late-night crashes for each state and each quarter. Predictor variables included time parameters for each quarter, cross-sectional parameters for each state, and indicator variables for Washington for the law changes.

Results for study of Washington state's interlock laws

Trends in conviction types and interlock installations

During 1999-2009, the quarterly number of convictions from DUI arrests fluctuated between about 8,000 and 10,500; consistently, about three-quarters were first convictions. A possible effect of interlock law changes would be shifts in DUI-related conviction types. The proportion of first DUI-related convictions that were alcohol-related negligent driving (without an interlock requirement) trended upward during 1999-2007 and then levelled off (Figure 1a). These convictions were about one-third of all first DUI-related convictions in 1999, 40% during 2005, and half at the end of 2009. The proportions of first high-BAC and test refusal DUIs and deferred prosecutions trended downward during 1999-2009. The proportion of first simple DUI convictions trended up from 1999 to mid-2003 and then down, until levelling off in 2008; these convictions were about one-third of first DUI-related convictions in January-March 1999 and in October-December 2009.

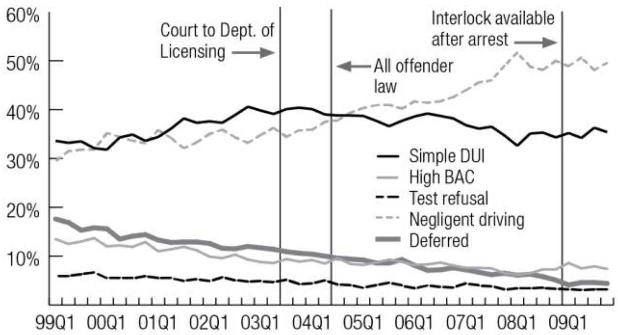

Figure 1a. Distribution of first DUI-related convictions by type, by arrest quarter, 1999-2009.

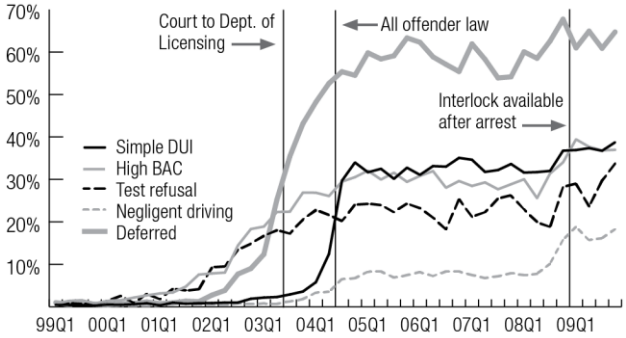

Figure 1b. Percent of first DUI-related conviction types with interlocks installed, by arrest quarter, 1999-2009.

After June 2004, when interlock orders were extended to first simple DUI convictions, the rate of installations was highest for deferred prosecutions, followed by first simple and high-BAC DUI convictions, and then first test refusal DUI convictions (Figure 1b). The installation rate for alcohol-related negligent driving convictions was about 8% until increasing in mid-2008 through 2009 to 16-19%. Interlock orders were not required for this group, but installing an interlock could be a condition of plea reduction agreements with courts. It is apparent that the 2004 law change led to a substantial increase in the interlock installation rate for first simple DUI offenses, the convictions directly affected (Figure 1b). The 2009 law change, which allowed an interlock-restricted license in lieu of a 30-day license suspension after arrest, appeared to increase installations for all conviction types. For first simple DUI convictions, the installation rate was very low prior to 2004. It then increased to 6% in the first quarter of 2004; to 13% in the second quarter, when some of these offenders were covered by the interlock requirement; and to 30% in the third quarter, after all were covered. The rate then remained at about one-third until the last quarter of 2008, when it increased to 37%. During the last quarter of 2009, interlock installations were recorded for 29% of all DUI-related convictions.

It also appears that the 2009 law change led to earlier installations of interlocks. As shown in Figure 2, first simple DUI offenders were not only more likely to install interlocks after the law change, but also more likely to install them sooner after arrest. For example, for first simple DUI offenders arrested during January 2004-December 2008, prior to the 2009 law change, 6% had installed interlocks by the end of 6 months after arrest, compared to 16% during 2009.

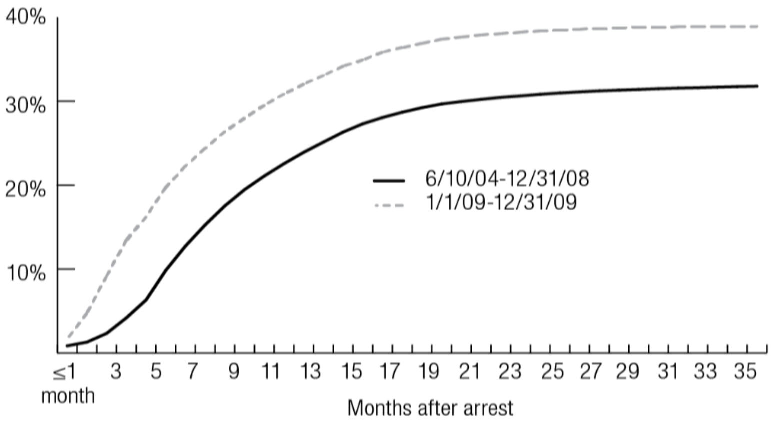

Figure 2. Cumulative percent of interlock installations by number of months elapsed after arrest for first simple DUI offenders arrested before (June 10, 2004-December 31, 2008) and after (January 1-December 31, 2009) January 1, 2009 law change.

Effects of 2003 and 2004 law changes and interlock installation rate on recidivism

The regression model for the 2-year cumulative recidivism rate for first simple DUI convictions estimated a reduction of 1.3 percentage points associated with the 2004 law change (p=0.04). For example, for offenders arrested during April-June 2006, the model estimates a 12% reduction, from an expected 10.6% recidivism rate without the law change to 9.3%. The model for all first DUI offenses estimated a 1.1 percentage point reduction (p=0.02). Neither model found a significant effect associated with the 2003 law change. To assist in interpreting the model results, Figure 3 shows trends in the rates of 2-year cumulative recidivism rates for first simple DUI convictions in the absence of the 2004 law change and the rates in the presence of the law change (after adjustment for covariates). The recidivism rates were generally increasing until the third quarter of 2004. They would have been expected to continue increasing and later level off (as in the dashed line) if there had been no law change. Instead, the rates declined.

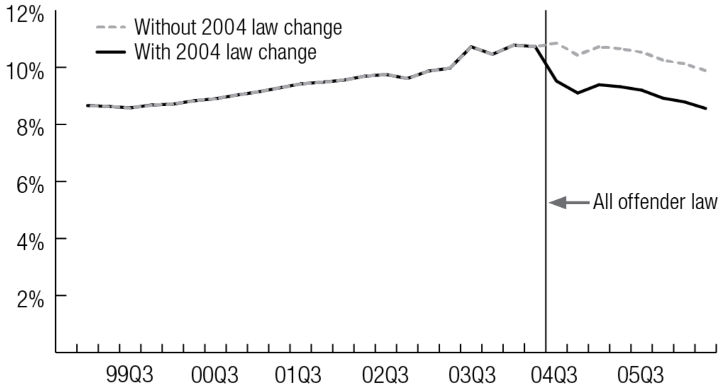

Figure 3. Predicted cumulative 2-year recidivism rate for first simple DUI convictions with and without 2004 law change, by quarter of arrest, January 1999-June 2006.

Regression models of the effect of interlock installation rates on recidivism rates indicated an estimated 0.06 percentage point decrease in the 2-year cumulative recidivism rate for each percentage point increase in the proportion of first simple DUI offenders with interlocks. An estimated 0.08 percentage point decrease in the recidivism rate of all offenders with DUI-related convictions is predicted for each percentage point increase in the interlock installation rate ($p=0.05$).

Effects of 2003 and 2004 law changes on crashes

Table 1 summarizes the regression model of the percentage of crashes that were single-vehicle late-night by state and quarter during 2001-07 (time-series parameters for each quarter not shown). The inverse logarithms of the cross-sectional parameters represent the predicted percentage of crashes that would be single-vehicle late-night at the end of the time series if trends were similar across states — i.e., 2.8 for California, 2.1 for Oregon, and 3.5 for Washington. The coefficient of the Department of Licensing parameter (2003 law change) is -0.06623, a non-significant estimate. The inverse logarithm of this parameter can be interpreted as a 6.4% decrease in single-vehicle late-night crash risk in Washington beginning in the third quarter of 2003, relative to trends in California and Oregon. The coefficient of the parameter for the all-offender interlock order requirement (2004 law change) is -0.08636, a significant estimate. The inverse logarithm of this parameter can be interpreted as an 8.3% decrease in single-vehicle late-night crash risk in Washington beginning in the third quarter of 2004.

Table 1. Police-reported crashes during 2001-07 in California, Oregon, and Washington: time series cross-sectional regression of log of deseasonalized single-vehicle late-night (midnight-3 a.m.) crash percent.

Variable	Parameter estimate	Standard error	t value	Pr > |t|
Cross sectional effect, California	1.046334	0.0308	34.01	<0.0001
Cross sectional effect, Oregon	0.725778	0.0308	23.59	<0.0001
Cross sectional effect, Washington	1.266336	0.0359	35.25	<0.0001
Change, DOL issuing interlock orders	-0.06623	0.0370	-1.79	0.0792
Change, all offender interlock order requirement	-0.08636	0.0354	-2.44	0.0183

Alcohol-related fatal crash trends for states with vs. without all-offender interlock laws

For all 50 states and the District of Columbia, interlock laws in each quarter during 2000-11 were coded as no mandatory interlock law or one or more of the following: law applying to repeat DUI convictions, law applying to high-BAC DUI convictions, law applying to first DUI convictions. Initial models were constructed for the percentage of fatal crashes that were single-vehicle nighttime (9 p.m.-6 a.m.) and the percentages of drivers involved in fatal crashes with BAC ≥ 0.08. The models included the logarithm of the seasonally adjusted percentage of crashes as the dependent variable and cross-sectional parameters for each state (the 10 states with no mandatory interlock law were grouped); indicators for quarters during which the repeat offender, high-BAC, or first-offender laws were in effect; and time-series parameters for each quarter. In these initial analyses, the data were highly variable and effects of the laws were small and not statistically significant. More complete analyses are underway. These will consider, for example, matching law-change states with nearby states without law changes and consider predictors such as the quarterly rate of unemployment in each state that may have affected alcohol-impaired driving trends during the study period.

Discussion and conclusions

The Washington law pertaining to ignition interlocks for DUI convictions has evolved by expanding the types of convictions covered, moving responsibility for issuing interlock orders from the courts to the driver licensing agency, and making interlocks available sooner after arrest. Extending an interlock order requirement to all first DUI convictions was associated with reductions in recidivism, even with low interlock use rates, and additional gains are likely achievable with higher use rates. A 2009 law change allowing interlock installation immediately after arrest, in lieu of a 30-day license suspension, appears to be having the desired effect of increasing installations and ensuring they occur more quickly after arrest. It is too soon to evaluate a major January 2011 law change, which provides that an unrestricted driver's license can be restored only after drivers have had an interlock installed for at least 4 months without any reports of noncompliance. Washington state and other jurisdictions should continue to identify ways to increase interlock use rates and reconsider allowing reductions in DUI charges to other traffic offenses without interlock order requirements.

The crash reduction associated with Washington state's all-offender law suggests that all-offender interlock laws can have a general deterrent effect. This is being further explored through cross-state analyses relating interlock laws to alcohol-impaired fatal crash trends.

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U.S. trends in late-night weekend alcohol-related fatal crashes and drinking and driving

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Abstract

Background

The proportion of U.S. drivers in fatal crashes with blood alcohol concentrations (BACs) of 0.08% or higher declined substantially from 1982 through the mid-1990s but changed little since, whereas periodic national roadside surveys reported large declines in alcohol use.

Aims

To examine possible explanations for the apparent disconnect between trends in drinking and driving and trends in the proportion of drivers with BACs ≥0.08% in fatal crashes.

Methods

The study looked at data from national roadside surveys conducted on Friday and Saturday late nights (10 p.m.-3 a.m.) in 1986, 1996, and 2007 and data on fatal crashes for these times and years. Differences in the roadside survey samples and protocols were examined, as were trends in rates of BACs ≥0.08% among driver sub-groups in the roadside surveys and FARS.

Results

Even after adjustments to the roadside surveys for differences in sampling and weighting, there were large declines in drivers with BACs ≥0.08% (5.4% in 1986, 4.2% in 1996, 2.6% in 2007) not reflected in rates of drivers with BACs ≥0.08% in fatal crashes (55.3% in 1986, 52.1% in 1996, 49.7% in 2007). Drivers with BACs ≥0.08% in fatal crashes were more likely than other drivers to drive older vehicles, be speeding, be unrestrained, and have prior moving violations and crashes/suspensions. Except for belt use, the differences were fairly consistent over time. Belt use increased more slowly among drivers with BACs ≥0.08%.

Discussion and Conclusions

Different methodologies of roadside surveys do not appear to explain why alcohol impairment in fatal crashes has declined much less than the rate of drinking drivers in general. Trends generally were similar for sub-groups of drivers in roadside surveys and in fatal crashes. The fact that drinking drivers have been slower to buckle up appears to account for some of the discrepancy in trends, but there also appear to be other unknown factors.

Introduction

There are two main sources of information on trends in alcohol-impaired driving in the United States. Since 1982, the Fatality Analysis Reporting System (FARS), a database of information on fatal motor vehicle crashes on public roads, has included information on the BACs of all drivers. BACs are based on a blood alcohol chemical test or, if test results were missing, an imputed BAC value (Subramanian, 2002). The percentage of drivers with BACs ≥0.08% (the *per se* threshold for alcohol-impaired driving in all states) declined steadily from 35% in 1982 to 22% in 1995 but remained at 20-22% during 1996-2011.

Periodic national roadside breath-testing surveys also track rates of alcohol-impaired driving. The first survey was conducted during fall 1973 at 185 sites representing all except the most sparsely populated parts of the contiguous United States (Wolfe, 1974). Sites were selected on relatively well-travelled roads in 24 primary sampling units (PSUs; counties, parts of counties, or central cities) randomly selected from the four major U.S. regions. Alaska, Hawaii, Puerto Rico, and counties with fewer than 20,000 people were excluded. Drivers were stopped during 10 p.m.-3 a.m. on Fridays and Saturdays and asked to take a breath test and answer questions related to alcohol use. Of these drivers, 8% tested at BACs ≥0.08%.

The surveys were repeated in 1986, 1996, and 2007 (Lund & Wolfe, 1991; Voas, Wells, Lestina, Williams, & Greene, 1998; Lacey et al., 2009). Sampling methodology was similar to that for the 1973 survey, but with a few differences. The survey periods were October 26-December 16 in 1973, April 18-June 15 in 1986, September 6-November 10 in 1996, and July 20-November 18 in 2007. Data from the 1973 and 1986 surveys were weighted to account for those drivers not providing valid BAC measurements. The 1996 and 2007 surveys expanded on this idea, using measurements taken on passive alcohol sensors (PASs) to impute BACs. The 2007 survey also included some daytime surveys (9:30 a.m.-3:30 p.m. on Fridays). The daytime measurements are not included in any year-to-year comparisons.

The proportion of U.S. drivers in fatal crashes BACs of 0.08% or higher declined substantially from 1982 through the mid-1990s but changed little since, whereas periodic national roadside surveys reported large declines in alcohol use. The present paper examines possible explanations for this conundrum.

Method

The study looked at data from national roadside surveys in 1986, 1996, and 2007, and data on drivers involved in fatal crashes for these years. Differences in the roadside survey samples and protocols were examined, as were trends in driver sub-groups of drivers with BACs ≥0.08% in the surveys and in fatal crashes. Data files of the national roadside surveys were obtained from the original researchers. Data on drivers in fatal crashes were extracted from the public FARS files, and excluded crashes in Alaska and Hawaii.

Results

Rates of drivers with positive BACs, BACs ≥0.08%, BACs ≥0.10%, and BACs ≥0.15% declined across the four surveys (Table 1). The percentage declines from 1973 to 2007 ranged from 66% for drivers with positive BACs to 73% for drivers with BACs ≥0.15%.

Table 1. Percent of drivers on Friday and Saturday nights (10 p.m.-3 a.m.) with positive BACs in National Roadside Alcohol Surveys.

	Year of survey						
BAC	1973	1986	% change 1986 vs. 1973	1996	% change 1996 vs. 1986	2007	% change 2007 vs. 1996
>zero	36.1	25.9	-28.1%	16.9	-34.7%	12.4	-27.0%
≥0.08%	7.6	5.4	-29.0%	4.3	-19.8%	2.2	-49.7%
≥0.10%	5.1	3.2	-36.7%	2.8	-14.0%	1.5	-45.7%
≥0.15%	1.4	1.0	-31.0%	0.6	-39.8%	0.40	-33.9%

For each survey, the estimated rate of drivers with BACs ≥0.08% was examined by driver age and gender, vehicle type, and region. In all but three cases, impairment rates declined over time. The rate was higher in 1996 than in 1986 for female drivers (3.0 vs. 2.2%), drivers of light trucks/vans (6.0 vs. 5.6%), and drivers in western states (8.5 vs. 5.5%).

The 2007 survey used a new procedure for imputing BACs of drivers either unwilling or unable to provide a breath sample. Whereas the 1996 imputed values were based solely on measures obtained with PASs, the 2007 imputed values were based on a statistical model that included the PAS measure, the driver's age and gender, the time of night (p.m./a.m.), and the interviewer's judgment of intoxication. A trend analysis should be based on consistent methodology, so the 2007 values were recomputed using 1996-style imputations. In addition, there seemed to be an anomaly in the 1996 estimated impairment rate for the West region, which was much higher than the rate for the other regions. This was not the case in the 1973 or 1986 surveys, and there were other instances in the 1996 survey where weights did not reflect expected relative traffic flows. This problem was addressed in the 2007 survey by using an additional level of weighting to account for the observed traffic density at sites. The 1996 survey data were reweighted using the 2007 PSU weights.

After making these two adjustments, impairment rates in the roadside surveys declined 29% from 1973 to 1986 (from 7.6% to 5.4%), 22% from 1986 to 1996 (from 5.4% to 4.2%) and 38% from 1996 to 2007 (from 4.2% to 2.6%) (Table 2). Rates of BACs ≥0.08% declined for almost all driver sub-groups. Declines were especially large for drivers younger than 21, whose rate of BACs ≥0.08% declined from 6% in 1973 to 0.6% in 1996 and was essentially unchanged in 2007 (1.0%).

Table 2. Percent of drivers on Friday and Saturday nights (10 p.m.-3 a.m.) with BACs ≥0.08% in National Roadside Alcohol Surveys, with adjusted 1996 and 2007 estimates.

	Year of survey						
Driver group	1973	1986	% change 1986 vs. 1973	1996[a]	% change 1996 vs. 1986	2007[b]	% change 2007 vs. 1996
Total	7.6	5.4	-29.0	4.2	-22.4	2.6	-38.2
Male	8.3	6.5	-21.3	5.0	-23.6	3.1	-38.2
Female	4.3	2.2	-49.2	2.5	16.1	1.8	-30.6
<Age 21	6.0	3.2	-47.4	0.6	-81.0	1.0	61.7
Ages 21-34	8.3	6.1	-26.8	5.5	-9.2	3.2	-41.3
≥Age 35	7.8	5.4	-30.8	3.4	-36.6	2.1	-39.5
Car/minivan	7.6	5.5	-28.4	3.8	-30.1	2.5	-34.7
Light truck/van	9.9	5.6	-43.6	5.5	-0.9	2.6	-54.0
Northeast	6.8	4.6	-32.9	4.2	-8.1	3.2	-23.5
Midwest	8.0	4.3	-46.0	5.4	24.5	2.8	-47.5
South	8.9	6.7	-24.4	2.5	-62.5	2.2	-11.5
West	5.8	5.5	-5.2	4.3	-22.6	2.3	-45.4

[a]Using PSU weights from 2007; [b]Using imputation method from 1996

Table 3 lists the percentage of drivers involved in fatal crashes on Fridays and Saturdays during 10 p.m.-3 a.m. for the study years with various categories of positive BACs based on alcohol test results. Data were not available for calendar year 1973, so 1975 data were used. The data included only the 19 states that tested at least half of fatally injured drivers for alcohol in all four years. The percentage of drivers with BACs ≥0.08% declined from 71.9% in 1975 to 66.6% in 1986, 62.7% in 1996, and 63.1% 2007. The big decline in impairment rates reported between the 1996 and 2007 roadside surveys (Tables 1-2) seems at odds with the essentially constant impairment rate reported for fatal crashes in these years.

Table 3. Percent of drivers in fatal crashes on Friday and Saturday nights (10 p.m.-3 a.m.) with positive measured BAC. [a]

	Year of crash involvement						
BAC	1975	1986	% change 1986 vs. 1975	1996	% change 1996 vs. 1986	2007	% change 2007 vs. 1996
>zero	83.3	79.6	-4.4	72.2	-9.3	72.3	0.2
≥0.08%	71.9	66.6	-7.3	62.7	-5.8	63.1	0.6
≥0.10%	65.5	61.2	-6.6	58.8	-3.9	58.8	0.0
≥0.15%	47.1	43.5	-7.6	41.1	-5.5	41.9	1.9

[a]Based on 19 states with at least 50% of fatally injured drivers tested in all four years

Using NHTSA's multiple imputation data allows for including all fatal crash-involved drivers in all states (Subramanian, 2002). However, these data are not available prior to 1982. Table 4 lists the rates of various BACs for drivers involved in fatal crashes on Friday and Saturday late nights. Modest declines occurred in all BAC categories.

Table 4. Percent of drivers in fatal crashes on Friday and Saturday nights (10 p.m.-3 a.m.) with positive reported or imputed BAC.

	Year of crash involvement				
BAC	1986	1996	% change 1996 vs. 1986	2007	% change 2007 vs. 1996
>zero	65.4	59.9	-8.4	57.9	-3.4
≥0.08%	55.3	52.1	-5.9	49.7	-4.6
≥0.10%	50.6	47.9	-5.3	45.7	-4.6
≥0.15%	35.3	34.0	-3.5	32.9	-3.3

The rates of drivers with BACs ≥0.08% in fatal crashes on Friday and Saturday late nights generally declined for each of the driver subgroups examined in the roadside surveys, but the declines were much smaller than those in the roadside surveys (Table 5). Thus, even after adjustments to the estimates from the 1996 and 2007 roadside surveys, there remains a large decline in alcohol use on the road that is not reflected in data from fatal crashes, and this disconnect remains when changes in impairment rates are examined for various driver subgroups. This suggests the relative risk of crash involvement associated with BACs ≥0.08% may have increased. One possibility is that the "typical" driver has changed. The percentages of young drivers have declined in the roadside surveys, and the percentage of female drivers has increased. Based on the estimated effects of alcohol on crashes (Zador, Krawchuk, & Voas, 2000; Voas, Torres, Romano, & Lacey, 2012), however, the aging of the population should be making the relative risk for a typical driver lower rather than higher.

Perhaps the remaining drivers who are impaired have other risk factors for involvement in fatal crashes. Table 6 compares several characteristics of drivers with BACs ≥0.08 and BACs <0.08 in fatal crashes on Friday and Saturday late nights in 1986, 1996, and 2007. Drivers with BACs ≥0.08 were more likely than drivers with BACs <0.08 to drive older vehicles, be speeding, be unbelted, and have prior moving violations and crashes or license suspensions. Except for belt use, the differences were roughly consistent over time. The relative risk of being unbelted for drivers with BACs ≥0.08 compared with other drivers increased from 1.3 in 1986 to 2.4 in 2007.

Table 5. Percent of drivers in fatal crashes on Friday and Saturday nights (10 p.m.-3 a.m.) with reported or imputed BAC≥0.08 percent for several driver subgroups.

	Year of crash involvement				
Driver group	1986	1996	% change 1996 vs. 1986	2007	% change 2007 vs. 1996
Total	55.3	52.1	-5.9	49.7	-4.6
Male	58.1	56.3	-3.1	53.5	-4.9
Female	40.9	39.6	-3.3	36.4	-8.0
<Age 21	46.5	37.7	-18.9	36.4	-3.4
Ages 21-34	64.0	61.0	-4.7	58.6	-3.9
≥Age 35	47.4	52.0	9.8	47.1	-9.5
Car/minivan	53.5	50.5	-5.7	46.7	-7.4
Light truck/van	60.3	60.7	0.6	56.5	-6.9
Northeast	53.0	48.7	-8.0	49.0	0.5
Midwest	59.1	56.2	-4.8	57.9	3.0
South	54.5	52.3	-4.0	48.8	-6.7
West	54.8	48.5	-11.6	44.6	-7.9

Table 6. Characteristics of drivers in fatal crashes on Fridays and Saturdays during 10 p.m.-3 a.m. with and without BACs ≥0.08.[a]

	Year of crash involvement					
	1986		1996		2007	
Percent with characteristic	BAC <0.08%	BAC ≥0.08%	BAC <0.08%	BAC ≥0.08%	BAC <0.08%	BAC ≥0.08%
Vehicle ≥5 years old	59.3	65.7	60.8	70.0	64.1	70.2
Driver unbelted	67.7	85.7	35.5	71.4	27.1	64.0
Driver speeding	23.1	47.6	20.8	44.5	20.2	43.0
Police report of other drugs	NA	NA	13.5	32.2	26.7	46.6
Prior moving violations	41.2	51.3	36.2	47.2	34.3	41.9
Prior crash/license suspension	25.7	36.2	26.4	36.5	23.9	33.5

[a]*Note:* For each characteristic, drivers with missing data were excluded.

Drivers impaired by alcohol were slower than unimpaired drivers to adopt the habit of wearing seat belts. This would have increased the relative risk of fatality for impaired versus unimpaired drivers. Using the driver impairment rates of Table 2, the belt use rates of Table 6, and NHTSA's estimate of a 45 percent reduction in fatality risk when wearing seat belts, the expected change in the percent of drivers in fatal crashes with BACs ≥0.08 was calculated controlling for belt use. The 22 percent decline in impaired drivers on the road during 1986-96 (from 5.4 to 4.2 percent) should have produced a 6 percent decline in impaired drivers in fatal crashes. This essentially is what was observed in Table 4. However, the 38 percent decline in impaired drivers on the road during 1996-2007 should have produced a 24 percent decline in impaired drivers in fatal crashes after accounting for belt use. The observed decline was only 5 percent.

Perhaps drivers with high BACs have become more likely also to have other drugs in their systems, thereby increasing their crash risk. Information in FARS on police-reported use of drugs other than alcohol and the results of drug tests became available in 1991. Table 6 shows the percentage of drivers in FARS for whom police reported the presence of other drugs in 1996 and 2007. The rate of reported use of drugs increased from 1996 to 2007 for both drivers with illegal BACs and other drivers. Drug test results also began to be reported in FARS in 1991, but test results are unavailable for a large portion of drivers. The 2007 National Roadside Survey, for the first time, asked drivers to provide oral and blood samples to test for drugs other than alcohol. The rates of drug presence were 12% for drivers with zero BACs, 33% for positive BACs <0.08%, and 45% for drivers with BAC≥0.08%. Thus, although drugs may be an increasingly important factor, complete and accurate historical data in either the roadside surveys or FARS are not available.

Discussion

Differences in methodologies of roadside surveys do not appear to explain why alcohol impairment in fatal crashes declined much less than the rate of drinking drivers in general. Trends generally were similar for driver sub-groups in the surveys and in fatal crashes. The slower adoption of seat belts among drinking drivers appears to account for some of the discrepancy in trends, but there also appear to be other unknown factors. An increase in the use of alcohol and other drugs among drivers might be a factor, but data are not available to determine this.

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The DRUID Categorisation and labelling system of medicines and driving

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Abstract

Context: Some commonly prescribed medications can be a hazardous to traffic safety.

Objectives: The DRUID Work Package 4 “Classification” aims to establish the bases and the methodology for the development of a European classification/labelling system for medicines with respect to their impact on fitness to drive, as well as to provide a classification of relevant therapeutic groups of medicines that are currently on the European Union market.

Key outcomes: DRUID WP4 proposed a 4 tier categories on medicines and driving:
• category 0 (no or negligible influence on fitness to drive),
• category I (minor influence on fitness to drive),
• category II (moderate influence on fitness to drive),
• category III (severe influence on fitness to drive).
In total 3054 medicines were reviewed, while over 1541 medicines were categorized (the rest were no longer in the EU market). The distribution of the 1,541 categorized medicines was as follows: Category 0 – 50,3%, Category I – 26,0%, Category II – 11,2%, Category III – 5,8%, Multiple category – 4,4% and the Depending on the medicine in combination 2,3%. Furthermore, patient-oriented information was produced for each one of the medicines categorized.

Discussion and conclusions: The current DRUID categorization system established and defined standard and harmonized criteria to categorize new and old medicines, based on their influence on fitness to drive. The proposed categorization system can be seen as a tool to improve prescribing and dispensing procedures of medications that impair driving as well as an instrument to make patients aware of the role of medications play in traffic safety. Further efforts are needed to finalized (example Anatomical Therapeutic Chemical groups of medicines G, H, J, L, P, V) and implement the DRUID categorization system worldwide and further activities should be undertaken in order to reinforce the awareness of Health Care Professionals and patients on the effects of medicines on fitness to drive.

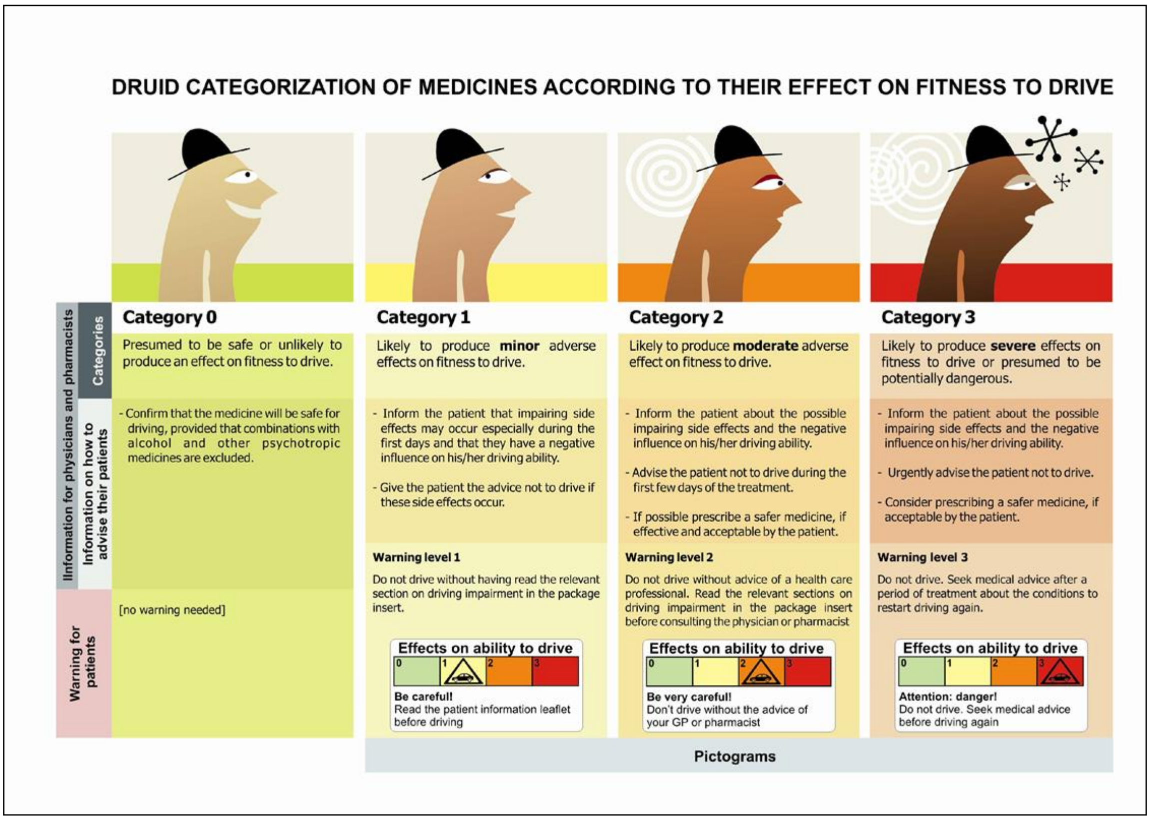
The DRUID categorisation/labelling on medicines and driving.

The full description and results of the DRUID categorisation/labelling on medicines and driving within the DRUID project has been described previously, and related documents are free available (DRUID Deliverable 4.1.1; 4.2.1; 4.3.1; 4.4.1; Ravera el at., 2012).

DRUID WP4 expert group established and agreed that, according to its influence on the ability to drive, a medicine could be categorized as follows regarding driving (Figure 1):

- category 0 (no or negligible influence on fitness to drive),
- category I (minor influence on fitness to drive),
- category II (moderate influence on fitness to drive),
- category III (severe influence on fitness to drive).

Figure 1: DRUID Categorisation and labelling system for medicines and driving (DRUID Deliverable 4.3.1).

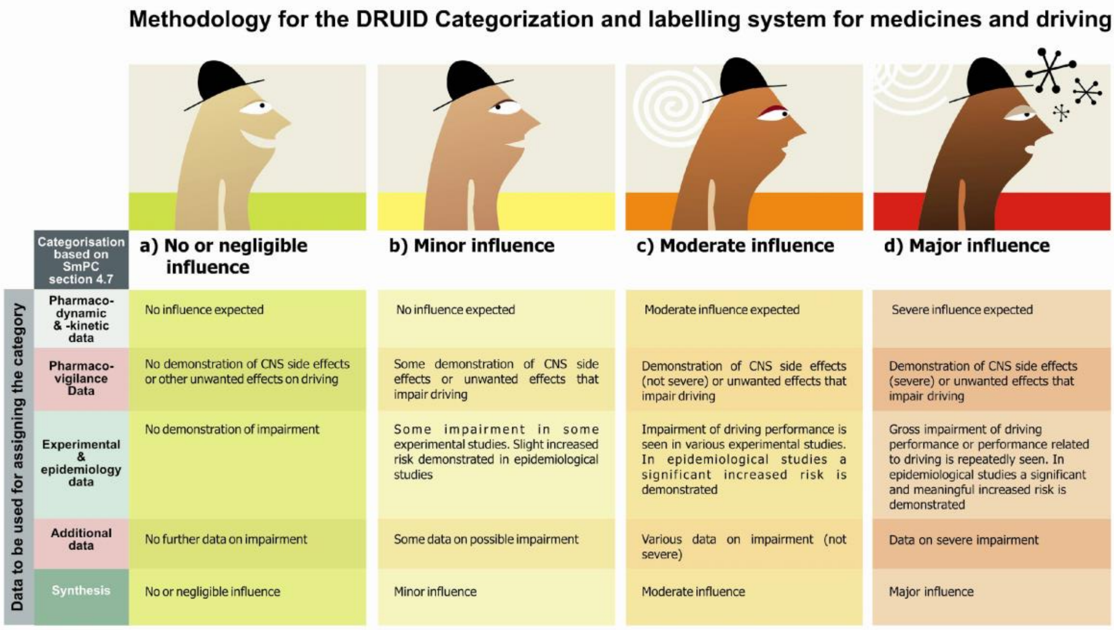


The development of the DRUID categorisation system was based on the criteria that were established by a group of experts in the field of drugs and driving, involved in DRUID WP4, and based on their consensus, which have been described in detail previously (Figure 2) (DRUID Deliverable 4.2.1; 4.3.1; Ravera el at., 2012;).

Following these criteria (Figure 2), available medicines on the European Union market were categorized. The following issues were analysed for each medicine:

1. Conditions of use of the medicine at the European Union market.
2. Pharmacodynamic and pharmacokinetic data.
3 Pharmacovigilance data (including prevalence of unwanted effects reported in the SmPC).
4. Experimental and epidemiological data.
5. Additional data derived from the Patient Information Leaflet (PIL) and existing categorisation systems, and information from other sources.
6. Synthesis and final categorization.

Figure 2: Methodology for the DRUID Categorisation and labelling system for medicines and driving (DRUID Deliverable 4.3.1).



Within the DRUID WP4, in total 3054 medicines were reviewed, while over 1541 medicines were categorized (the rest were no longer in the EU market). The distribution of the 1,541 categorized medicines was as follows: Category 0 – 50,3%, Category I – 26,0%, Category II – 11,2%, Category III – 5,8%, Multiple category [when a medicine could be included in more than one category, for example depending on the route of administration]– 4,4% and the Depending on the medicine in combination [when the categorization depend on the combination of the medicine under evaluation with another active substance] 2,3%. Most medicines belong to category 0 or I. The full list of medicines categorized could be find elsewhere (DRUID Deliverable 4.4.1; Ravera el at., 2012). Table 1 shows the distribution of the medicies categorized for each Anatomical Therapeutic Chemical (ATC) group.

Table 1. Number of medicines categorised by ATC group.

ATC GROUP	**Not evaluated OR Not available at EU market**	**DRUID Categorisation** 0	I	II	III	Multiple categories	Depending on the medicine in combination	**TOTAL**
A - ALIMENTARY TRACT AND METABOLISM	243	234	69	8	1	4	4	563
B - BLOOD AND BLOOD FORMING ORGANS	86	135	1	1			2	225

C - CARDIOVASCULAR SYSTEM	246	90	200	11		1		548
D - DERMATOLOGICALS	156	192	1			4		353
M - MUSCULO-SKELETAL SYSTEM	88	22	44	28	15			197
N - NERVOUS SYSTEM	346	9	30	86	53	36		560
R - RESPIRATORY SYSTEM	195	62	24	32	10	5	14	342
S - SENSORY ORGANS	153	31	31	6	11	18	16	266
TOTAL	1513	775	400	172	90	68	36	3054

The DRUID Patient-oriented information

DRUID WP4 partners have produced patient-oriented information for each one of the medicines categorized. The aim of producing this patient-oriented information is to help physicians and pharmacists (and other health professionals) in providing appropriate information to their patients. It is true that Patient Information Leaflets contain some sort of information regarding driving. However, DRUID WP4 partners considered that it is also quite important that health professionals provide further information for medicines and driving to their patients. Table 2 show some examples of patient-oriented information concerning the DRUID categorisation of the evaluated medicines. We have selected as an example the medicines from the M group, Musculoskeletal system medicines (DRUID Deliverable 4.3.1). The full list patient-oriented information for each medicine could be find elsewhere (DRUID Deliverable 4.4.1).

Table 2: Information to the patient and Categorisation and labelling of some available M - MUSCULOSKELETAL SYSTEM MEDICINES on driving (DRUID Deliverable 4.3.1).

M MUSCULOSKELETAL SYSTEM	**ACTIVE SUBSTANCE**	**CATEGORY LABELLING**	**INFORMATION FOR THE PATIENTS**
M01AB01	Indometacin	I	- Inform the patient that the medication can cause side effects that impair driving and that reaction time can also be reduced without experiencing side effects. - Advise the patient also to be careful in other situations than driving (e.g. using machinery and working at heights) - Advise the patient to avoid any alcohol or other psychoactive substances during the treatment.
M01AB02	Sulindac	I	
M01AB05	Diclofenac	I	
M01AB08	Etodolac	I	
M01AB11	Acemetacin	I	
M01AB15	Ketorolac	I	
M01AB16	Aceclofenac	I	
M01AB51	Indometacin, combinations	I	
M01AB55	Diclofenac, combinations	I	
M03AA01	Alcuronium	III	- Advise the patient not to drive or operate machinery until the effects of the anaesthetic, and the immediate effects of surgery have passed. - Advise the patient (and explain to caregivers) not to drink any alcohol 24 hours after anaesthesia
M03AA02	Tubocurarine	III	
M03AA04	Dimethyltubocurarine	III	
M03AC01	Pancuronium	III	
M03AC02	Gallamine	III	
M03AC03	Vecuronium	III	
M03BA01	Phenprobamate	II	- Inform the patient about the effects of the medicine on reaction time and that
M03BA02	Carisoprodol	II	

M03BA03	Methocarbamol	II	the medication can cause side effects that impair driving (dizziness, drowsiness, sleepiness, blurred/double vision and reduced alertness) - Advise the patient not to drive for the first few days of treatment or until the next visit after the start of treatment and also to be careful in other situations (e.g. using machinery and working at heights) - Advise the patient not to drink alcohol or use other psychoactive substances when taking this medicine. - One time (occasional) use: inform your patient that his/her response is reduced. Advise your patient not to drive then.
M03BA04	Styramate		
M03BA05	Febarbamate	II	
M03BA51	Phenprobamate, combinations excl. psycholeptics	II	
M03BB02	Chlormezanone	II	
M03BB03	Chlorzoxazone	II	
M03BB52	Chlormezanone, combinations excl. psycholeptics	II	
M04AC01	Colchicine	0	- No special advice
M05BA02	Clodronic acid	0	- No special advice

Categorisation and labelling of medicines approved by the EMA January 2008-September 2010

Within DRUID we have also provided a classification/categorisation for the "new" medicines approved by the EMA from January 2008 to September 2010. Table 3 shows the new medicines approved by the European Medicines Agency during this period. The categorisation of these new medicines has been carried out using the methodology previously described, showing that the methodology and procedures used is valid. As an example we presented the categorization for the Antiinfective medicines (DRUID Deliverable 4.3.1).

Table 3: Categorisation and labelling of "new" medicines approved by EMA from January 2008 to September 2010 (DRUID Deliverable 4.3.1).

J ANTIINFECTIVES FOR SYSTEMIC USE				
ATC code	**ACTIVE SUBSTANCE**	**INVENTED NAME**	**CATEGORY**	**LABELLING**
J01DF01	Aztreonam	CAYSTON	0	0
J01DH04	Doripenem monohydrate	DORIBAX	0	0
J02AX05	Micafungin (as sodium).	MYCAMINE	0	0
J05AG04	Etravirine	INTELENCE	I	I
J06BA02	Human normal immunoglobulin (IVIg)	PRIVIGEN	I	I
J06BB04	Human hepatitis B immunoglobulin	ZUTRECTA	0	0
J07AH	Meningococcal Group A, C, W-135 and Y Coniugate Vaccine	MENVEO	I	I
J07AL52	Streptococcus pneumoniae polysaccharide serotypes 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F and 23F each conjugated to a carrier protein (Pneumococcal vaccine)	SYNFLORIX (indicated for children from 6 weeks up to 2 years of age)	Not Evaluated (Only paediatric patients)	Not Evaluated (Only paediatric patients)
J07BA02	Japanese Encephalitis vaccine, inactivated, adsorbed	IXIARO	I	I
J07BB02	Pandemic influenza vaccine (H5N1) (split virion, inactivated, adjuvanted) A/VietNam/1194/2004 NIBRG-14	PANDEMRIX	I	I

Conclusions:

The current DRUID categorization system established and defined standard and harmonized criteria to categorize new and old medicines, based on their influence on fitness to drive. The proposed categorization system can be seen as a tool to improve prescribing and dispensing procedures of medications that impair driving as well as an instrument to make patients aware of the role of medications play in traffic safety. Next steps and recommendation s have been analized in detail previously (Ravera el al ., 2012; DRUID Deliverable 4.2.1): To highlight, there is a need to finalized (example Anatomical Therapeutic Chemical groups of medicines G, H, J, L, P, V) and update de DRUID categorization and labelling on medicines, and the patient-orieted information. There is a need to implement the DRUID categorization system worldwide and further activities should be undertaken in order to reinforce the awareness of Health Care Professionals and patients on the effects of medicines on fitness to drive.

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Poor impulse control and heightened attraction to alcohol-related imagery in repeat DUI offenders

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Abstract

Background
Research suggests that DUI offenders have an increased prevalence of alcohol abuse and higher levels of impulsivity compared with drivers with no history of DUI. However, reports linking alcohol consumption, impulsivity, and DUI offenses are primarily based on self-reports and fail to identify specific behavioral and cognitive mechanisms that might underlie impulsivity and contribute to the recidivism of drinking and driving offenses.

Aims
This study directly assessed inhibitory control and attention to alcohol-related images in first-time versus recidivist DUI offenders.

Methods
Three groups of subjects participated in the study: repeat DUI offenders (those with two or more DUIs within a five year period), first-time-DUI offenders, and control drivers with no history of a DUI offense. Subjects performed a visual probe task that measured their attention toward alcohol-related images and a go/no-go task that assessed their inhibitory control.

Results
There were no differences in the quantity or frequency of drinking among the three groups. Repeat offenders reported more alcohol-related problems, greater cognitive preoccupation with alcohol and higher trait impulsivity compared with the other drivers. Repeat offenders also displayed greater attention toward alcohol-related cues and poorer inhibitory control compared with first-time offenders and drivers with no history of DUI. By contrast, first-time offenders did not differ from non-offenders in inhibitory control, attention to alcohol, cognitive preoccupation with alcohol, or trait impulsivity.

Discussion and Conclusions
Findings from this laboratory study highlight potentially important differences in cognitive and behavioral mechanisms between recidivist DUI offenders and first-time offenders. The results indicate that deficits in inhibitory control and attentional bias toward alcohol may underlie the heightened levels of impulsivity commonly self-reported by DUI offenders. Moreover, attentional bias to alcohol and poor inhibitory control might be especially characteristic of repeat offenders and possibly undermine treatment and prevention efforts in this population.

Introduction

Alcohol-related traffic fatality and injury are a major public health problem. According to the National Highway Traffic Safety Administration, approximately 30% of all fatal crashes in North America are related to alcohol (NTSA, 2012). Unfortunately, efforts aimed at reducing the incidence of driving under the influence (DUI) have only been modestly effective. In fact, over one third of individuals who are convicted of DUI are repeat offenders, highlighting the difficulty of treating DUI offenders and, more specifically, re-offenders (Nochajski & Stasiewicz, 2006). The issue of driving while intoxicated has primarily been considered a problem related to alcohol abuse and dependence. As such, many DUI programs are aimed at addressing heavy consumption. However, many DUI offenders, and specifically younger offenders do not typically meet *DSM* criteria for alcohol abuse or dependence (Lapham et al., 2004; NHTSA, 2011). Thus, it is likely that there are additional factors beyond dependence-level consumption that contribute to the propensity to drink and drive.

Lack of evidence for alcohol dependence among younger DUI offenders reflects the emerging view that DUI is not merely a function of heavy consumption, but reflects deficient behavioral regulation and reward sensitivity (Ryb et al., 2006). DUI offenders self-report traits of impulsivity. One particular component of impulsivity concerns inhibitory control, or, the ability to inhibit pre-potent behaviors. Laboratory studies use reaction time models such as stop-signal and cued go/no-go tasks that measure the ability to inhibit action (e.g., Fillmore, 2003). Such "stop processes" are imperative for inhibiting inappropriate or maladaptive behaviors. As such, deficits in inhibitory control might be an especially important factor contributing to DUI because drinkers are unable to stop themselves from getting into a car and driving after consuming alcohol.

Along with deficient inhibitory control, heightened appetitive processes might also be an important process that underlies the propensity to drink and drive. Evidence that alcohol-related images can elicit reactions reliably in drinkers has led to studies aimed at testing the possibility that such cues actually come to dominate the drinker's attention. Laboratory studies have begun employing eye tracking technology to directly assess the degree to which drinkers attend to alcohol versus neutral-related stimuli. Attentional bias is observed by greater amounts of time spent visually attending to alcohol images compared with neutral images. It is posited that heightened attentional bias reflects motivation to consume alcohol, and greater attentional bias has been shown for heavier compared with lighter drinkers (Miller & Fillmore, 2011). Therefore, individuals who display a significant degree of attentional bias to the alcohol cues they encounter in their environment might be motivated to drink in situations in which they did not originally intend to, such as those in which they might need to drive.

Taken together, there is evidence to suggest that poor stop processes coupled with heightened attentional bias might result in an increased incidence of drinking and driving behavior. Traditional studies of the characteristics of DUI offenders have chiefly focused on the drinking habits and personality traits of these drivers. Moreover, treatments aimed at reducing the rates of DUI have been primarily aimed at reducing consumption. Unfortunately, these efforts have only been minimally effective. Thus, it is important to identify additional mechanisms that might contribute to drunk driving and its recidivism in order to develop more effective treatment programs. The present study aimed to examine the specific behavioral and cognitive mechanisms that might underlie the impulsivity and drinking problems related to DUI by assessing attentional bias and inhibitory control in DUI offenders. We hypothesized that recidivist DUI offenders would exhibit poorer inhibitory control and increased attentional bias compared with both first-time DUI offenders and non-offenders. The findings will highlight specific processes that contribute to the recidivism of drinking and driving offenses, and as such, can inform new programs aimed at reducing the rates of DUI offenses.

Methods

Subjects

Subjects were 53 adults between the ages of 21 and 40 years. Sixteen subjects were first-time DUI offense (11 men and 5 women), 11 subjects were repeat DUIs (9 men and 2 women), and 26 were control subjects with no DUIs (11 men and 15 women). First time DUI offenders had to receive a DUI offense in the past two years. Recidivist DUI offenders had to receive two or more DUIs within a five year period, with the most recent offense occurring within the past two years. Finally, control subjects had no history of any arrests/convictions for DUI. All DUI convictions were verified by state district court records. All subjects held a valid driver's license for at least 5 years and drove on a regular (i.e., weekly) basis. Subjects were recruited by newspaper, websites, and community bulletins that invited individuals to participate in studies of cognition, drinking habits and driving history. Some advertisements specifically targeted adults with previous DUI offenses. All subjects were current consumers of alcohol and their typical weekly consumption (i.e., quantity and frequency) was assessed. The University of Kentucky Medical Institutional Review Board approved the study, and subjects received $60 for their participation.

Apparatus and Materials

Visual Probe Task Attentional bias was measured by a visual probe task. During the task, two pictures (a neutral and an alcohol-related image) were presented side-by-side on the computer screen while subjects completed a reaction time task. Ten alcohol-related images were matched with ten neutral (i.e., non-alcohol-related) images. In addition, there were filler presentations consisting of two neutral images. All image pairs were randomly intermixed. Throughout the task, an eye tracker was used to measure subjects' visual fixations toward the image pairs. Attentional bias was determined by the degree to which fixation time was greater on the alcohol images compared with the neutral images.

Cued Go/No-Go Task Inhibitory control was measured by the cued go/no-go task. This reaction time task requires subjects to respond quickly to go targets and inhibit responses to no-go targets. Response inhibition is measured by the proportion of no-go targets in which subjects fail to inhibit a response (p-inhibition failures). Participants were told that they would be paid for fast responses (i.e., earning $0.05 for responses less than 255 ms), but would lose money for each incorrect response (i.e., losing $0.05 for responding to no-go targets).

Short Michigan Alcoholism Test (SMAST) (Selzer, Vinokur, & van Rooijen, 1975). The SMAST provides an assessment of alcoholism and alcohol-related problems. Items concern whether the participant's drinking has caused problems with family/friends, the legal system, or with health/safety.

Barratt Impulsiveness Scale (BIS-11) The BIS-11 assesses the personality dimension of impulsivity. Higher total scores indicate higher levels of self-reported impulsiveness. Scores range from 30 to 120.

Temptation and Restraint Inventory (TRI) (Collins & Lapp, 1992) The TRI was used to provide a measure of drinker's general trait-like preoccupation with the temptation to drink, and with attempts to restrain oneself from drinking. Items are rated on a Likert scale that ranges from 1 (*never*) to 9 (*always*). The measure of interest for this study was the degree to which participants are cognitively and emotionally preoccupied with drinking, the (CEP) scale, which represents the degree to which individuals display a cognitive bias toward alcohol.

Procedure
Subjects attended a single testing session. During the session, they completed questionnaires regarding their drinking habits, drinking-related problems, and personality. They also completed the visual probe and cued go/no-go tasks. Participants were each tested individually, and were paid $60 for their time

Results

There were no significant group differences in ages between the three groups (p >0.05). The mean ages were 28.5 (SD = 6.4) years for controls, 26.4 (SD = 5.6) years for first-time offenders, and 28.9 (SD = 5.9) years for repeat offenders.

Table 1 presents the mean scores for drinking habits and drinking-related problems for the three groups. One-way analyses of variance (ANOVA) tested group differences among the drinking habit measures and SMAST scores. There was no effect of group for either the frequency or quantity of the sample's reported drinking. There was, however, a significant effect of group on SMAST scores, F (2, 50) = p < 0.001. *A priori* pair-wise comparisons revealed that both the first-time and repeat DUI offenders reported significantly greater alcohol-related problems than controls on the SMAST (ps < 0.05). SMAST scores for the repeat offenders were also higher compared with the first-time offenders (p < 0.05).

	Group								
	Control (a)		First-time (b)		Repeat (c)		Pair-wise comparisons		
Measure	M	(SD)	M	(SD)	M	(SD)	a vs. b	a vs. c	b vs. c
Frequency	2.2	(1.9)	2.8	(1.9)	2.2	(1.6)			
Quantity	3.6	(2.0)	4.8	(1.9)	5.4	(3.3)			
SMAST	1.5	(2.7)	6.5	(5.2)	17.2	(8.5)	*	*	*

Table 1. *Frequency = number of drinking occasions per week; Quantity = number of standard drinks per drinking occasion; SMAST= total score from the SMAST*
Asterisks (*) indicate a significant difference between the two groups, p < 0.05

Table 2 presents the mean scores for the questionnaires regarding cognitive preoccupation with drinking (TRICEP), impulsivity (BIS), and the mean performance scores on the visual probe and cued go/no-go tasks. One-way ANOVAs revealed significant effects of group for TRICEP scores, BIS scores, attentional bias, and inhibitory control, ps < 0.05. Pair-wise comparisons showed that there were no significant differences on any of the measures between the control group and the first-time offenders. By contrast, the repeat offenders reported higher impulsivity, more preoccupation with alcohol, greater attentional bias, and poorer inhibitory control than both the controls and the first-time offenders (ps < 0.05).

	Group								
	Control (a)		First-time (b)		Repeat (c)		Pair-wise comparisons		
Measure	M	(SD)	M	(SD)	M	(SD)	a vs. b	a vs. c	b vs. c
BIS Total	64.1	(7.9)	65.9	(8.9)	72.2	(16.2)		*	*
TRI-CEP	23.1	(12.5)	28.4	(16.3)	40.0	(20.8)		*	*
Attentional bias	31.7	(73.1)	16.2	(52.6)	108.4	(123.5)		*	*
Inh. control	0.04	(0.06)	0.04	(0.03)	0.11	(0.13)		*	*

Table 2. *BIS Total = Total score on the BIS-11; TRI-CEP = total score on the cognitive and emotional preoccupation subscale of the TRI; Attentional Bias = difference score between fixation times to alcohol versus neutral images on the visual probe task; Inh. control = proportion of inhibitory failures on the cued go/no-go task*

Discussion and Conclusion

This study aimed to identify potential cognitive and behavioral mechanisms that might play a role in drinking and driving by comparing repeat DUI offenders with first-time and non-offenders on measures that assess inhibitory control and attentional bias. With regard to drinking habits, DUI offenders, including both first-time and repeat offenders, did not report significantly greater alcohol consumption compared with control drivers. However, both of the DUI groups reported greater alcohol-related problems on the SMAST, compared with controls. What is more, repeat DUI offenders appear to experience even more problems from drinking compared with first-time offenders even though they do not report drinking more frequently or in greater amounts. The SMAST contains items that refer to legal problems that stem from drinking, including arrests and convictions of DUI. Thus, the higher scores in the DUI groups and in the recidivist group in particular, likely reflect the problems associated with DUI offenses.

The study also showed that repeat DUI offenders report higher levels of cognitive and emotional preoccupation with alcohol as well as greater attentional bias toward alcohol-related stimuli compared with first-time offenders and controls. These results indicate that repeat offenders are more drawn to stimuli associated with alcohol compared with the other groups. Additionally, consistent with previous work, repeat offenders report higher levels of trait impulsivity compared with the other drivers. Moreover, repeat offenders demonstrated poorer inhibitory control based on their greater proportion of inhibitory failures on the go/no-go task compared with the first-time offenders and controls. What is more, the first-time offenders did not differ at all from the controls on any of these measures.

This work is the first to study the inhibitory control and attentional bias in repeat DUI offenders compared with first-time offenders. The findings highlight striking differences in the inhibitory and appetitive processes between these groups of offenders, whereby repeat offenders displayed a marked difficulty inhibiting their behavior and attended more to alcohol-related stimuli compared with first-time offenders and non-offenders. There were no differences among the groups with regard to the frequency and quantity of alcohol consumption. Therefore, the results suggest that poor behavioral regulation coupled with heightened approach tendencies might underlie the propensity to drink and drive in repeat offenders as opposed to problematic drinking that reflects dependence. As such, treatment approaches might be aimed at improving inhibitory mechanisms and reducing attentional bias in offenders in an effort to reduce the likelihood that these individuals will continue to drink and drive.

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Alcohol and Drug Use among Fatally Injured Pedestrians Involved in Motor Vehicle Accidents

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Abstract

Background
Knowing the fact that a pedestrian under the influence of alcohol could increase the chance of being hit by a motor vehicle, recently, the attention has been given not only to drink-and-drive but also drink-and-walk.

Aims
This paper will highlight and give emphasize on drink-and-walk, instead of drink-and-drive. Therefore, finding and discussion will tailor toward alcohol use among fatally injured pedestrian. The specific aim of this paper is to highlight the problem and pattern of alcohol use among fatally injured pedestrian in the city of Kuala Lumpur, Malaysia.

Methods
A retrospective data collection was conducted covering all fatal road traffic injury cases for the period of 2006 to 2009. The data on alcohol use was retrieved from the medical post mortem files obtained from the Hospital Kuala Lumpur's Department of Forensic Medicine.

Results
A total of 670 fatally injured road traffic injury cases were identified. Of these, 505 cases were eligible for substance use analysis where pedestrian accounted for 10.9% (55 cases). The study revealed that 20.0% of the fatal pedestrians were positive for alcohol, 5.5% positive for drug and 5.5% were positive for both drug and alcohol. Male were predominant (88.2%) as compare to female. Higher percentage of substance use was noticed among brought-in-dead cases (41.0%) compared to dead-in-department cases (6.25%). By time of day, more death associated with positive alcohol occurred during night time.

Discussion and conclusions
This study highlights an alarming problem of drink-and-walk in the city area of Kuala Lumpur. There is a need to expand the study to other cities in Malaysia in order to know the extent of the problem. This study also highlights the need to emphasize on the issues of drink-and-walk and prevention activities should also address this vulnerable group of road users.

Introduction

Driving under the influence of alcohol is one of the well-documented risk factors for road traffic accident (WHO, 2004). As it is proven to increase the risk of road accident injuries and fatalities, many efforts as well as interventions were set up in order to deter drivers from drinking driving. Recently, the attention has been given not only to drink-and-drive but also to drink-and-ride and drink-and-walk. This is very important especially in the ASEAN region as most people travel by motorcycle and by walking especially in the city areas where most of the needed facilities or zones for safe crossing or walking are rarely available.

In South East Asia, about 50% of the region's road traffic deaths are among vulnerable road users. Specifically, 33% of deaths are among motorized two or three wheelers followed by 12% pedestrians, and 4% cyclists (WHO, 2013). Meanwhile, Malaysian police statistic indicates that 1,859 pedestrians were involved in road traffic casualties in 2011, which death accounted for 28.5% and severely injured 22.5%.

Intoxication among pedestrians has long been identified as a risk factor in pedestrian crashes (Haddon et al. 1961, Honkanen et al. 1976; Struik and Rogerson 1988; Oksana TH 1995). The prevalence of alcohol use among injured pedestrians is well documented. Öström and Eriksson (2001) revealed that blood alcohol was detected in 19% of autopsied pedestrian fatalities (286 victims) in northern Sweden from 1977 to 1995, with a median concentration of 1.6 g/l. Meanwhile, National Highway Traffic Safety Administration reported that in 2009, 35% of all United State fatally injured pedestrians had BACs above 0.08 g/dL (NHTSA, 2010).

Despite the fact that pedestrians are vulnerable to be hit by a motor vehicle, most countries especially in ASEAN region including Malaysia do not have data to reflect the real problem of alcohol use among fatal or seriously injured pedestrians. This was the first study that tried to discover the problem of alcohol use among fatally injured drivers and pedestrian involved in road traffic crashes in Malaysia. However, the aim of this paper is to highlight the problem and the pattern of alcohol use among fatally injured pedestrian in the city of Kuala Lumpur.

Methodology

Design and study population

This was a retrospective study, which included all road traffic deaths admitted to the Hospital Kuala Lumpur's Department of Forensic Medicine from 2006 to 2009. The protocol of the study was approved by MIROS's Research Committee and Research and Ethic Committee, National Institute of Health, Ministry of Health Malaysia. The study's findings represented the problem in the area of Kuala Lumpur.

Data sources

Data for this study was mainly retrieved from the medical post-mortem files which include (toxicology reports) obtained from the Department of Forensic Medicine, Hospital Kuala Lumpur consists of post-mortem report number, police report number, personal identification number, age, gender, ethnic group, time of crash, date of crash, type of crash, type of road user, type of vehicle, type of case, type of substance use, concentration of substance use, and injury details.

Based on personal identification and police report number, the records from the post-mortem files were matched with the police-based accident data. Information on time of crash, date of crash, type of crash, type of road user, type of vehicle were cross-checked with the police-based data. With regard to crash information, the police-based accident data will be used if there was any discrepancy among the sources of data. The results of alcohol or drug use were also crosschecked with the police-based data.

Since the study was retrospective in nature, all data obtained were from secondary data source. With regard to toxicology sample, preservation material used and procedures of sample transportation and data analysis were not intervened in this study. However, for the purpose of the report, it is explained in this paragraph. All samples were sent for toxicology analysis according to the standard procedure practiced by the Department of Forensic Medicine. According to the Department of Forensic Medicine, since 2006 they have been using free of alcohol preservative sample bottles that contained Natrium Flouride (NaF) as its preservative. The specimen security seal from the Forensic Medicine Department, Hospital Kuala Lumpur were affixed before the samples were sent to an accredited laboratory at the Department of Chemistry Malaysia.

Results

A total of 710 fatal road traffic deaths were registered at the department for the period of 2006 to 2009. Out of these, 670 (94.4%) were eligible for data collection as their post-mortem reports have been completed and not classified as "sensitive cases". Out of 670 cases, 505 cases had toxicology results attached and eligible for substance use analysis. Of those 505 cases, 55 cases (10.9%) involved pedestrians referring to fatal pedestrian cases eligible for substance use analysis.

Incidences of Substance Use among Fatal Pedestrian

The study revealed that of those 55 cases involving fatally injured pedestrian, 17 (30.9%) cases were either positive for alcohol or drug or both. Breakdown by specific substance, 20.0% were positive for alcohol, 5.5% positive for drug and 5.5% were positive for both drug and alcohol. Distribution of the substance use cases by gender indicates that 88.2% involved men with the highest prevalence among age group of 50 to 59 (33.3%) followed by age group of 30 to 39 (26.7%) years old. Higher percentage of substance use was noticed among brought-in-dead cases (41.0%) compared to dead-in-department cases (6.25%).

Incidences of Substance Use among Fatal Drivers and Pedestrian by Age

In general, this study also revealed that the percentage of alcohol-positive only among all drivers (driver, riders, and cyclist) was 23.3%, 11.0% positive for drug and 2.3% positive for both drug and alcohol. The highest substance use was reported among pedestrian in the range of age between 50 to 59 years old (29.4%) followed by age group of 20–29 (23.5%) and 30–39 (23.5%). In contrast, the age group 30-39 show the highest percentage among driver, motorcyclist and cyclist with 43.3% (CI 95%; 33.1–53.5) followed by (20–29) and (40–49) with 39.7% (CI 95%; 32.4–47.0) and 41.2% (CI 95%; 25.1– 57.3) cases respectively. The comparison can be seen in Figure 1 below.

Distribution of Fatal Drivers and Pedestrian with Positive Substance Use by Day and Time of Accident

Figure 2 shows the distribution of cases with substance use by type of road users and day. It was noted that the distribution of positive substance cases (the number of cases with positive substance use in a day divided by the total number of cases) among pedestrian is highest on Tuesday (3.8%) followed by Thursday (3.6%), Sunday (2.7%) and Saturday (2.7%). This distribution is in contrast with positive substance use cases among drivers, motorcyclist and cyclist which is highest on Saturday (20.3%) followed by Sunday (17.5%) and Wednesday (16.1%).

The trend of accidents related to positive substance use by driver increase from 0000–0600 hours. The highest number of accidents related to positive substance use occurs between 0400–0559 hours with 42.0%, followed by 0000-0159 with 35.1%. After 0600 hours, the number of accidents related to positive substance use decreased and increased again after 1200 hours. In contrast to pedestrians, the number of accidents related to positive substance use increases after 1600 hours with highest prevalence occurring between 2000-2159 with 10.2%, followed by 2200-2359 with 5.0%. A clearer comparison is presented in Figure 3 below.

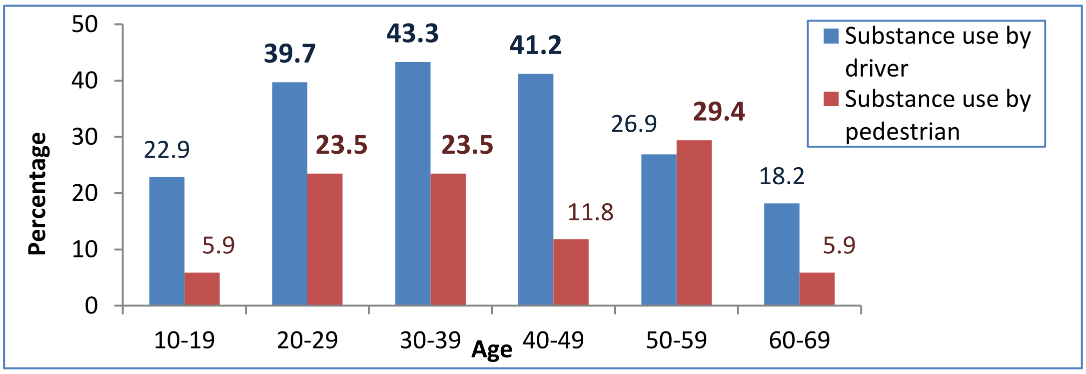

Figure 1: Percentage of substance use by type of road users and by age

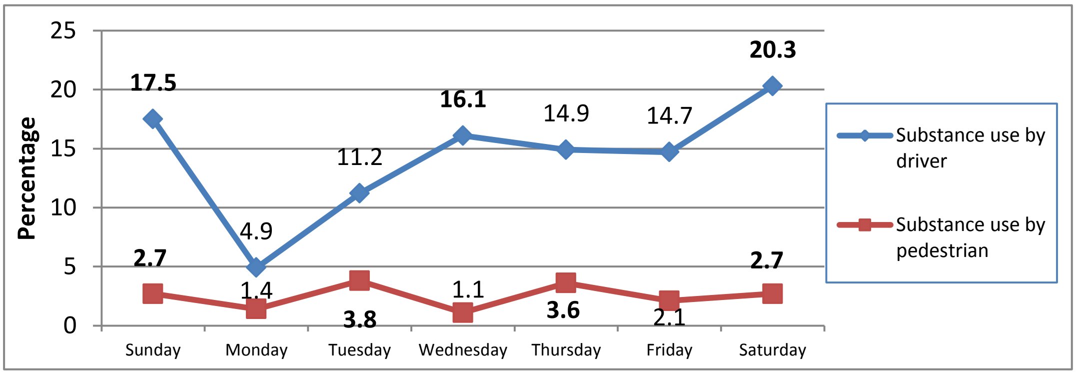

Figure 2: Distribution of cases with substance use by type of road users and day

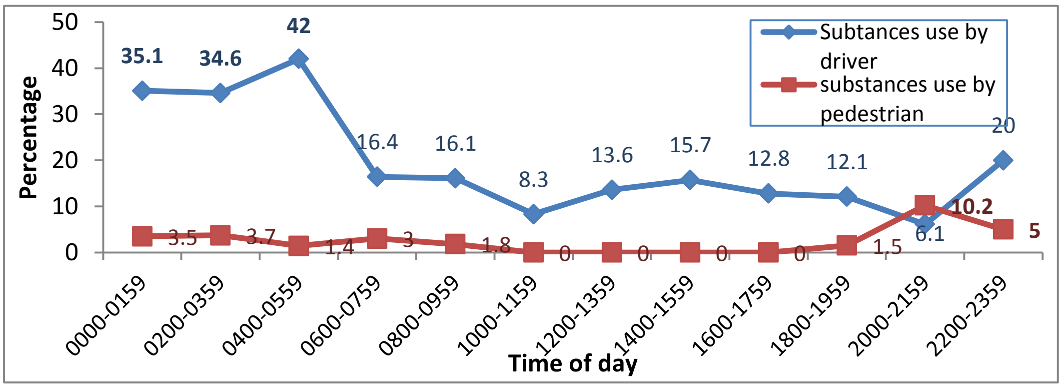

Figure 3: Distribution of cases with substance use by type of road users and time

Discussion

The study found that walking while under the influence of alcohol and drug among pedestrian involved in fatal crashes is alarming. The findings reveal that among fatally injured pedestrian about 20.0% were positive for alcohol, 5.5% positive for drug and 5.5% were positive for both drug and alcohol. Recently, in other high income countries, the attention has been given not only to drink-and-drive but also to drink-and-ride and drink-and-walk. Attention and thoughtful concern should be given by other countries especially in low-income and middle-income countries because of its great variety of traffic mix inclusive of vulnerable road users such as motorcyclist and pedestrians (WHO, 2004). In fact, vulnerable road users are at greater risk of crash involvement compared to other vehicle occupants.

Finding of this study also highlight the issues of under reporting in the police-based data especially for pedestrians as the police data is directly linked to the prosecution. Currently, drink-and-walk is not enforceable as there is no legal BAC limit for pedestrian. To have data, not to mention being a reliable data system especially for pedestrians hit by motor vehicles due to under the influence of alcohol and drug is the biggest challenge for most countries. It is fully understood that sufficient and reliable data, which lead to sound analysis, is critical to derive and drive an intervention. However, the fundamental issue is that does a country have enough data to support the policy and program implementation being for vulnerable road users, especially in developing and under developed countries? In Malaysia, on average 0.7% of drivers and riders involved in fatal accidents were related to under the influence of alcohol. No data for fatally injured pedestrians was reported. Based on this figure, none of the decision makers will spend scarce resources for preventing alcohol related crashes.

Another challenge in drink-and-walk issues is the limited support for legal action. Unlike, drivers and motorcyclist were subject to a legal blood alcohol limit, which prevents them from driving while under influence. For instance, in Malaysia, as mentioned in the Road Traffic Act which is applicable for all types of drivers, it is an offence to drive a vehicle with a BAC over the legal limit of 0.08 g/dl (RTA 1987). However the law is not applicable for pedestrian. As there is no specific regulation for intoxicated pedestrians, hence they could not be deter or controlled from walking or crossing roadways. Suggestion for introduction of a legal limit specifically for pedestrian should be given thorough consideration by policy makers depending on its necessity and suitability of implementation. Alternatively, other protection of pedestrians could be implemented through protective custody legislation. For example, as in South Australia, through the Public Intoxication Act, the police have the right to detain without arrest any intoxicated pedestrian for reasons of their own safety (Oksana, 1995). Besides, other possible countermeasures including public education or awareness should be distributed intensively to community. The public should be made aware and well understood on the risk of crash involvement when walking on or across a roadway while intoxicated. However, in Malaysia, to the author's knowledge, there is no road safety education or awareness which focuses on the drink-and-walk ever been delivered to the public.

The current study has its limitation as the source of fatally injured pedestrian was only from the Department of Forensic Medicine of Kuala Lumpur Hospital, the findings of the study could only be generalized to the population of pedestrians in the city of Kuala Lumpur. Thus, further investigations and research is needed in order to gains better understanding of the extent of the drink-and-walk problem in this country.

Conclusion

This study shows an alarming result of alcohol and drug use among fatally injured vulnerable road users which include pedestrians and riders involved in motor vehicle accidents. This finding highlights the problem of drink-and-walk besides drink-and-drive. There is a need to expand the study to include more locations in order to know the magnitude of the problem. It is also a need to come out with a comprehensive review to address the gap so that BAC legal limits for specific vulnerable road users can be proposed to address drink-and-walk.

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Pictograms concerning driving-impairing medicines: preference and effectiveness

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Abstract

Background

Pictograms to communicate the risks of driving under the influence of medicines were developed and studies evaluating its effectiveness were conducted. However, most studies failed to compare similar pictograms and discarded the preferences of participants known to be prone to misunderstand pictogram's messages.

Aims

To evaluate and compare the preference for and effectiveness of two pictograms (rating and triangle pictograms) in communicating risk, in terms of understanding and intention to change driving behaviour.

Methods

This study among 270 patients visiting a pharmacy involved a 2 (rating model pictogram versus triangle model pictogram) by 3 (categories of impairment: minor driving risk versus moderate driving risk versus severe driving risk) between-subjects design. Participants (n=30 per condition) were exposed to one of three conditions in which the risk message and the risk category (category 1, 2 or 3) were manipulated.

Results

The majority of participants preferred the rating model to express warning messages and levels of impairment. Older and lower educated participants showed less preference for the rating model. Participants related the rating model pictograms to risk significantly more often than the triangle pictograms. Those exposed to the triangle model overestimated the driving risk of the pictogram reflecting a minor risk for driving and underestimated the pictogram reflecting a severe risk. 78.8% of the participants reported they were likely to change their driving behaviour.

Discussion and conclusions

Despite not fully self-explanatory in conveying warnings and safety-related information, pictograms under assessment gave good insight on the different levels of driving risks, especially the rating model pictogram, as participants' intention to change driving behaviour increased with higher risk categories. Pictograms should consider older and lower educated

adults' preference into account in order to effectively reinforce written and oral information given to all patients by their healthcare professionals.

Background

In 2005, the European Union (EU) suggested the introduction of a compulsory and harmonised pictogram on medicines' packaging for driving-impairing medicines. Some European countries already developed pictograms showing the potential risk of driving-impairing medicines but only in France and Spain the use of pictograms on the package of such medicines is legally binding. France is the only country where a 3-tier labelling system was developed and printed on the box of all medicines depending on their level of risk (category 1 to 3, Figure 1) (AFSSAPS. 2009,Orriols et al. 2010) which can be seen as an advantage when compared to other pictograms that make no distinction between different levels of risk. A new pictogram system (Figure 1) was developed within the European DRUID (DRiving Under the Influence of Drugs, medicines and alcohol) project (DRUID project. 2006) as a proposal to communicate the risk of driving under the influence of medicines to patients.

Despite the clear advantages associated to its use, pictograms are figures representing ideas and concepts which may not always be clear to all, affecting the comprehension of the message (Wolf et al. 2006, Davis et al. 2006). Older and low educated adults are recognized to be particularly vulnerable to misunderstandings and often times have difficulties interpreting the message being conveyed (Wolf et al. 2006, Davis et al. 2006).

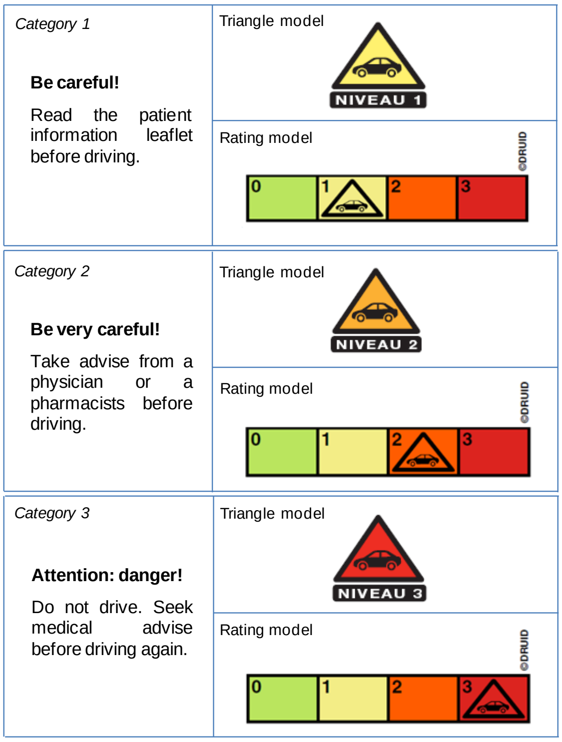

Figure 1 – Triangle model (developed in France) and rating model (developed within DRUID project). The 3 pictogram categories are displayed for both pictogram systems as well as the side-text.

Aims

The aim of the this study was to evaluate and compare the effectiveness of the rating and triangle model pictograms in communicating risk associated with driving-impairing medicines in terms of understanding, estimated level of driving risk and intention to change driving behaviour. Additionally, it was also investigated older and lower educated adults' preference for the same pictograms.

Methods

Study design

This study among patients visiting a pharmacy involved a 2 (rating model pictogram versus triangle model pictogram) by 3 (categories of impairment: minor driving risk versus moderate driving risk versus severe driving risk) between-subjects design. Participants were exposed to one of three conditions in which the risk message and the risk category (category 1, 2 or 3) were manipulated. The structured experiment involved 270 participants visiting 1 out of 4 selected Dutch community pharmacies located in Groningen. Inclusion criteria were matched for participants 1) actively participating in traffic with motorized vehicles; 2) aged 18 years or older and 3) being able to speak and read Dutch. The interview was carried out in Dutch and participants were interviewed in the waiting area of the pharmacy by a research associate. Data-collection stopped once 270 participants were included

Measurements

Understanding of the pictogram: First, respondents were asked to give their free interpretation of the pictogram they were exposed to. Respondents' answers were categorized as 1) not correct (low level of understanding of the meaning of the pictogram) if answers were not traffic-related nor related to the category; 2) traffic-related answers but describing a different category than the one shown; 3) traffic-related answers without a reference to the risk mentioned by the risk category; and 4) fully correct (high level of understanding) whenever participants' answer was traffic-related with a correct reference to the risk depicted by the pictogram category.

Evaluation of the pictograms: Respondents were asked to rate the pictogram on five items with a 7-point semantic differential scale which has been used in a previous study (van Weert et al. 2011). Items related to perceived ease (1=difficult; 7=easy), clarity (1=not clear; 7=clear), complexity (1=complex; 7=not complex), ease of understanding of the pictogram (1=difficult to understand; 7=easy to understand) and level of ambiguity (1=ambiguous; 7=not ambiguous) were used to estimate respondents' overall evaluation of the pictograms. Cronbach's alpha of the overall scale was 0.90.

Estimated level of driving risk: Respondents could select one of the options given by a 5-point Likert scale ranging from harmless (1) to very dangerous (5). The options were, thereafter, coupled with the categories of impairment as follows: Category 0: Likert scale option 1 and 2 = very safe and safe; Category 1: Likert scale option 3 = little danger; Category 2: Likert scale option 4 = dangerous; and Category 3: Likert option 5 = very dangerous. The questions on risk perception were developed specifically for this study.

Intention to change driving behaviour: To answer the question "how likely would you change your driving behaviour if this pictogram was affixed to your medicine box?" a 5-point Likert scale was used (1 = very unlikely to 5 = very likely). Participants were also asked how they would change their driving behaviour if a pictogram was shown on the medicine box.

Answers to this question were driving equally, slightly less often, less often, much less often, and not anymore.

Pictogram preference: The pictogram preference (triangle or rating model pictograms) was investigated by asking participants "which pictogram better expresses the warning message?". Age and education level were the main independent variables.

Results

The total study population was equally distributed in terms of gender (N = 137; 50.7% males). The mean age of the participants was 48.4 years-old and almost half of the respondents had a university degree (N = 123; 45.6%).

Understanding of the pictogram

72.2% of the participants who were shown one of the triangle model pictograms (N = 90) did not make any reference to any category of impairment, against 46.7% and 36.0% of the respondents who looked at the rating model with and without side-text, respectively. The percentage of fully correct answers (traffic related with correct reference to categories of risk) was significantly higher with the rating model pictograms when compared to the triangle one (experiment 1; $X^2(3, N = 180) = 23.939$, $p < .001$). Age and education level did not statistically influence the interpretation of the pictograms (age; $X^2(6, N = 270) = 6.025$, $p = .420$) and education level; $X^2(6, N = 270) = 9.250$, $p = .160$).

Evaluation of the Pictograms

Respondents were asked to rate the pictograms in items related to perceived ease, clarity, complexity, ease of understanding of the pictogram and level of ambiguity. The mean evaluation scores for each pictogram system (rating model with side-text, triangle model and rating mode without side-text) were, respectively, 5.80 (s.d = 1.12), 5.55 (s.d = 1.12), and 5.76 (s.d = 1.25). Overall, the pictograms were evaluated in the same manner by respondents. Results showed no significant interaction effects between risk category and pictograms on the evaluation of the pictograms.

Estimated Level of Driving Risk

The overall estimated level of driving risk (1=harmless; 5=very dangerous) was not significantly different among the pictogram systems ($F(2,267) = 0.029$; $p = .972$, $\eta 2 < .001$). However, results showed a significant interaction effect between risk category (category 1 and 3) and pictograms (triangle model and rating model), $F(1,116)=6.062$, $p=.015$, $\eta 2=0.05$. There was no difference in estimated driving risk between category 1 and 3 of the triangle model. However, respondents exposed to category 1 of the rating model estimated a lower level of driving risk than those exposed to category 1 of the triangle model, while respondents exposed to category 3 of the rating model estimated a higher level of driving risk than those exposed to category 3 of the triangle model.

Intention to Change Driving Behaviour

Considering the intention to change driving behaviour, 78.8% (213 out of 270) of the respondents stated to be likely or very likely to change their behaviour, regardless the pictogram or the category presented. The intention to change driving behaviour (considering all categories of risk) did not significantly differ among pictorial systems ($F(2,267) = 1.443$; $p = .238$, $\eta 2 = .01$). Results showed a significant interaction effect between risk category (category 1 and 3) and pictograms (triangle model and rating model), $F(1,116)=9.288$, $p=.003$, $\eta 2=0.07$. This indicates that, similarly to the estimation of levels of driving risk, respondents exposed to the lower category of the rating model were less willing to change their driving behaviour as compared to respondents exposed to the same category of the triangle model. However, respondents exposed to category 3 of the rating model were more willing to change their driving behaviour as compared to respondents exposed to category 3 of the triangle model.

Pictogram preference

The percentage of participants preferring the rating model (201 out of 270; 74.4%) to express a warning message was significantly higher than those preferring the triangle model (69 out of 270; 25.6%), $X^2(1,270)=12.6$, $p<.001$. Statistically significant differences between preference for one pictogram and age were found, $F(2, 267)=6.39$, $p=.002$; older adults (≥ 60 years old) were more likely to prefer the triangle model pictogram over the rating model. This group significantly differ from middle aged participants ($p=.035$) and younger participants ($p=.002$) which have shown preference for the rating model pictogram to express a warning message. Statistically significant differences were found, $F(2,267)=4.67$, $p=0.01$between pictogram preference and education level; participants with lower education were more likely to prefer the triangle model whereas participants with intermediate and high education levels preferred the rating model pictogram to express a warning message.

Discussion and conclusions

Results showed that the rating model pictogram with and without side-text was associated with more correct answers than the triangle model (35.6% *versus* 7.8%, respectively). However, if one considers that the correct answer does not need to make reference to the category of the pictogram, the percentage of correct answers would be essentially the same in both pictogram systems (80% for the triangle model against 82.3% for the rating model). In this case, both pictograms could be considered as comprehensible according to the ISO 3864 norm (Dowse et al. 2001,Mansoor et al. 2004). This indicates that the definition of correct answers used may have been too strict. Nevertheless, it should be stressed that these pictograms alone are unlikely to provide the complete message. This relates with the fact that respondents linked the pictogram to traffic related message but the majority failed to successfully associate it to the exact risk message. This supports the idea that pictograms are relevant when used in combination with oral and/or written information, given by healthcare providers, to avoid misinterpretations of any kind (Dowse et al. 2005,Katz et al. 2006).

Regardless the type of pictogram, respondents associated higher categories with higher levels of driving risk which led to higher estimations of danger. This outcome shows that, despite the lower percentage of fully correct answers regarding understanding of the pictogram, respondents were able to link the different levels of driving risks to a pictogram category. Category 1 pictograms of the rating model were significantly less associated with danger than the homologue from the triangle model indicating that respondents tend to overestimate the lower categories of the triangle model pictogram and to underestimate the higher ones. In the authors' opinion, this could mean that the triangle model pictogram does not fully illustrate the magnitude of risk as good as the rating model because no reference to the number of categories is made making it difficult for the target population to perceive the exact risk.

The rating model pictogram was preferred over the triangle model pictogram to express both a warning message and levels of impairment in all age groups and education levels. However, older and low educated participants demonstrated to have less preference for the more complex rating model and they were also less likely to change their opinion towards this more complicated model. This study confirmed that both age and education level are sensitive aspects to be considered when designing a pictogram to be equally well understood by older adults and those who have a low education level.

As conclusion, the pictograms in our study were not fully self-explanatory in conveying warnings and safety-related information as the majority of the respondents did not fully understand the meaning of the pictograms. The rating model pictogram generated more correct answers compared to the triangle model used in France. Despite the moderate level of understanding, respondents associated the high categories of risk to more dangerous situations, indicating a good estimation of driving risks. Moreover, in the presence of the pictograms used in this study, respondents were willing to change their driving behaviour, by driving less frequently. Future research should focus on how effective pictograms are in communicating a risk message when complementing oral or written information given to patients by healthcare providers.

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Increasing alcohol interlock participation rates in Canada: Best practices and effects of insurance

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Abstract

Context
Alcohol interlocks are an effective means of reducing recidivism among impaired driving offenders. However, interlock programs in Canada and elsewhere have suffered from low participation rates, and thus have not achieved their optimal traffic safety potential. Moreover, many offenders who do not participate in an interlock program choose instead to drive without a licence or insurance. These unlicensed drivers are overrepresented in fatal crashes and expose the public to the risk of uncompensated losses and injuries.

Objectives
To review the alcohol interlock programs across Canada and identify possible barriers to participation. Having determined the provinces[1] with the highest participation rates, this paper identifies program features that are most conducive to increasing participation.

Key Outcomes
The provinces with the highest interlock participation rates generally have the most inclusive mandatory programs that apply to the greatest number of federal impaired driving offenders. In these jurisdictions, enrollment in the interlock program is a condition of relicensing, preventing offenders from simply "waiting out" the hard licence suspension period. Most of these provinces also reduce the minimum licence suspension period to encourage offenders to install an interlock.

Discussion and Conclusions
The provinces and territories should design their alcohol interlock and related policies to maximize participation rates. This would include making interlock participation mandatory for all federal impaired driving offenders and shortening the provincial licence suspensions that would otherwise apply. The total costs of an impaired driving conviction, including insurance, should be kept at a level that does not encourage offenders to forego the interlock program and drop out of the licensing system altogether. Enhancing the provincial licence check and vehicle impoundment programs would increase the risks associated with driving unlicensed and thus would likely further increase interlock participation rates. In turn, this would have significant traffic safety benefits.

Introduction
Alcohol interlocks have been recognized as an effective and important component of the strategy to deal with impaired drivers (Beirness & Marques, 2004; National Highway Traffic Safety Administration (NHTSA), 2010). Research indicates that impaired driving offenders with interlocks on their vehicles have significantly lower recidivism rates during that period than offenders who do not (The Cochrane Collaboration, 2009, p. 8; NHTSA, 2007, p. 11). For example, a 2007 New Mexico study found that offenders with an interlock on their vehicle had a 66% lower recidivism rate during that period than comparable offenders

[1] Unless otherwise indicated, reference to the provinces should be interpreted as including the territories.

serving hard licence suspensions (Roth, Voas, & Marques, 2007, p. 24). A Florida study found that offenders who installed an interlock had an 80% lower recidivism rate over a two-year period than offenders who received only a licence suspension (Voas, Tippetts, Fisher, & Grosz, 2010, p. 1426). Similar positive results have been reported in Canada (Voas, Marques, Tippetts & Beirness, 1999; Vezina, 2002).

Increasing interlock participation rates also has significant traffic safety benefits. For instance, a recent Washington State study estimated that if the participation rate of first offenders had been 100%, rather than the actual rate of 24%, the offenders' two-year cumulative recidivism rate would have fallen from 9.1% to 3.2% (McCartt, Leaf, Farmer, & Eichelberger, 2012, p. 16). The study also indicated (p. 18) that if all drivers in the United States with a single impaired driving conviction within the past three years had been kept from driving after drinking, nearly 650 crash deaths would have been prevented in 2010.

Moreover, increasing interlock participation decreases the risk that impaired driving offenders will drive while suspended. As a group, suspended drivers have very high rates of alcohol-related fatal and personal injury crashes (Scopatz, Hatch, DeLucia & Tays, 2003, p. 8). An Ontario study reported that crashes involving drivers suspended for impaired driving were 3.5 times more likely to be fatal than crashes among the general driving population (MADD Canada, 2007, p. 21). These suspended drivers were also 16.3 times more likely to have been impaired when involved in a fatal or personal injury crash (p. 31) and almost 14 times more likely to try and flee (p. 22).

Finally, because suspended drivers are uninsured, they expose the public to the risk of suffering losses and injuries for which there is no third-party compensation (Solomon, Hanc, Ricci, & Visser, 2005, p. 38-40). In contrast, drivers subject to interlock orders are much less likely to drive while impaired (Elder et al., 2011, p. 367) and, in any event, are at least partially insured against third-party liability if they cause a crash.[2] Unfortunately, interlock programs in Canada and other jurisdictions have struggled with low participation rates (Beirness & Marques, 2004, p. 301; Elder et al., 2011).

The legislative framework governing impaired driving in Canada

The federal government has used its constitutional authority over criminal law to enact the *Criminal Code* impaired driving offences and their penalties. For example, the federal offences of impaired driving, driving with a blood-alcohol concentration (BAC) above .08%, and refusing to participate in a required impairment test each carry a minimum sentence of a $1,000 fine and a one-year driving prohibition for a first offence. In 1999, this provision was amended to allow the one-year minimum federal driving prohibition for first offenders to be reduced to three months for interlock participants. In 2001, the *Criminal Code* was further amended to permit the minimum federal driving prohibition to be reduced to six and twelve months, respectively, for second and subsequent offenders enrolling in an interlock program.

The federal government does not administer any alcohol interlock programs. Rather, this falls to the provinces, which can impose administrative licence sanctions pursuant to their constitutional authority over driver and vehicle licensing. Although most provinces have

[2] A driver subject to an interlock order who drives a vehicle that is not equipped with an interlock is considered an unauthorized driver. In most provinces, the driver's third-party coverage would be limited to the statutory minimum (generally $200,000), regardless of how much additional third-party coverage he or she had purchased. Moreover, the insurance company could attempt to recover from the unauthorized driver any third-party damages that it had to pay (Solomon, Hanc, Ricci & Visser, 2005, p. 38-40).

some form of interlock program for federal impaired driving offenders, these vary greatly in terms of inclusion criteria, the duration of the interlock orders, and conditions for relicensing (Chamberlain & Solomon, 2012).

The provinces also have constitutional authority over automobile insurance. In British Columbia, Saskatchewan, Manitoba, and Quebec, automobile insurance is administered by a public agency and is tied to vehicle and driver licensing. In others, the government simply regulates the private insurance industry. In either case, the provinces have authority over insurance rates, including those of impaired driving offenders. Clearly, the provinces have sufficient legislative power to implement interlock programs and related measures that would maximize participation rates.

Interlock participation rates in Canada
Table 1 sets out the number of interlock orders as of December 31, 2011 and the number of drivers convicted of a federal impaired driving offence from July 1, 2010 until June 30, 2011. These figures were used to provide an estimate of the percentage of offenders enrolled in interlock programs in each jurisdiction. Because the reporting periods for interlocks and convictions are not coextensive, the estimated participation rates provide merely rough approximations. Since most provinces do not mandate interlock participation for all offenders and/or limit eligibility, they would have to amend their traffic act to create the potential for 100% participation.

Table 1: Interlock Participation Rates among Federal Impaired Driving Offenders in Canadian Provinces and Territories

Province/ Territory	Interlocks: 31/12/2011	Impaired Driving Convictions: 2010/11	% of Offenders in Interlock Programs
AB	2,180	5,738	38%
BC	1,188 *	5,591	21%
MN	155	1,771	9%
NB	137 **	1,209	11%
NL	89	608	15%
NS	599	1,586	38%
NT	0	158	0%
NU	0	66	0%
ON	6,209	13,414	46%
PE	85	321	26%
QC	9,533 ***	6,483	139%
SK	400	2,672	15%
YU	24	167	14%
Canada	**20,559**	**40,144**	**51%**

* In addition to the interlocks imposed on federal impaired driving offenders, 6,841 interlocks were imposed under the "provincial administrative interlock" program. These latter interlocks are not factored into the participation rate of federal impaired driving offenders.
While no other province separately reports these two categories of interlock orders, relatively few provincial administrative interlocks were imposed in the remaining provinces. Nevertheless, these additional interlock orders somewhat inflate the preceding estimates of participation among federal impaired driving offenders.

** This is the number of interlocks installed throughout 2011, not the number in operation as of 31/12/2011.

*** Quebec had far more federal offenders in its interlock program at the end of 2011 than convictions in 2010/2011, due to the significant number of long-term interlock orders and the very high participation rates.

Key features in provinces with higher participation rates

In this section, we outline the aspects of the interlock programs that appear to have been conducive to participation, focusing on provinces with participation rates in excess of 20%, namely Alberta, British Columbia, Nova Scotia, Ontario, Prince Edward Island, and Quebec. While our commentary is based on the programs as of December 2011, significant changes have been made in the last two years. A summary of the current mandatory interlock programs is provided in the Appendix.

Mandatory interlock program

Enrollment in an interlock program should be a mandatory relicensing requirement for all federal impaired driving offenders. Not surprisingly, the provinces with the highest participation rates had the most inclusive mandatory programs. In British Columbia and Ontario, the interlock program was mandatory for all *Criminal Code* impaired driving offenders, including those convicted of refusing or failing a required impairment test. In Alberta, Nova Scotia, Prince Edward Island, and Quebec, only repeat offenders, those with a BAC above .16%, or other "high-risk" offenders were required to participate.[3]

As their name suggests, mandatory interlock programs require offenders to install an interlock at some time prior to regaining full licensure. Offenders cannot simply "wait out" the hard suspension period, an option that many would otherwise take to avoid the cost, inconvenience and stigma of installing an interlock (NHTSA, 2010a, p. 26). In most provinces, the minimum length of the interlock order was one year for first offenders, and two or three years for repeat offenders.[4] A lifetime interlock order applied to with a third impaired driving offence in Ontario and a fourth offence in Manitoba (Chamberlain & Solomon, 2012, p. 349).[5]

Reduced hard suspension for interlock participants

Evidence suggests that offenders are less likely to participate in an interlock program if it is preceded by a lengthy hard licence suspension (NHTSA, 2010a, p. 26). Accordingly, reduced provincial licence suspensions can be used to motivate offenders to enter a program. This was recognized by the federal government when it reduced the mandatory federal driving prohibitions for interlock participants in 1999 and 2001.

Most of the provinces with relatively high participation rates shortened the provincial licence suspensions for some categories of federal offenders who enrolled their interlock programs. Nova Scotia and Prince Edward Island reduced the provincial licence suspension for all federal interlock participants.[6] This incentive was not available to the more serious categories of impaired driving offenders in Quebec and Ontario, and was discretionary in Alberta.[7] These limits on reduced provincial licence suspensions may reflect deference to victims or government concern about being viewed as "going soft" on impaired driving offenders (Beirness & Marques, 2004, p. 306).

Enhanced enforcement

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[3] Alberta, Manitoba and Prince Edward Island have since expanded their mandatory programs to include all alcohol-related *Criminal Code* impaired driving offences.

[4] Alberta and Prince Edward Island have since increased the length of their minimum interlock orders, and both jurisdictions now impose a minimum five-year interlock order on third-time offenders.

[5] In Manitoba, the offender may apply to have the lifetime interlock order shortened.

[6] In Ontario, the reduced licence suspension applies only to first offenders. Moreover, the mandatory hard licence suspension is three months for those who plead guilty and six months for those who do not.

[7] Alberta has since reduced the hard provincial licence suspension for all federal impaired driving offenders who enroll in its interlock program.

Early relicensing may not alone be sufficient to motivate offenders to participate in an interlock program. Many offenders will choose to avoid the expense and inconvenience of using an interlock device, and drive while suspended (NHTSA, 2010a, p. 6; Voas & Marques, 2003). The laws against driving while suspended need to be strengthened and more effectively enforced. This may include: enhanced vehicle impoundment and immobilization legislation; more effective licence verification programs; and broader police powers to demand and, if appropriate, seize drivers' documentation. If offenders perceive that there is a greater risk of apprehension and punishment for driving while suspended, they will probably be more willing to enroll in an interlock program.

All of the provinces with higher interlock participation rates, and most others, have some form of vehicle impoundment program for suspended driving. However, current mechanisms for identifying suspended drivers, even if they are stopped by the police, appear to be largely ineffective. The provincial licensing agencies and police do not consistently seize the licences of impaired drivers who are suspended. For example, a Moncton Area study found that 91% of suspended drivers stopped at a roadside check program provided the police with an apparently valid driver's licence (Malenfant, Van Houten, & Jonah, 2002, p. 441-42). The ease with which impaired driving offenders can forgo the interlock program and drive while suspended significantly undermines the interlock programs and, more broadly, the impaired driving laws (Voas et al., 2010; NHTSA, 2010a).

Licensing measures are also required to prevent interlock participants from driving vehicles not equipped with an interlock. Of the provinces with higher interlock participation rates, Alberta, British Columbia, Ontario, and Prince Edward Island indicate on the driver's licence that he or she is subject to an interlock order (MADD Canada, 2008, p. 17). Thus, unless the driver is using a forged or another person's licence, the police will be alerted to the driver's status and can take appropriate action if the vehicle is not equipped with an interlock.

Insurance rates

While the cost of installing and maintaining the interlock is often cited as a barrier to participation (NHTSA, 2010b, p. 27; DeYoung, 2002; NHTSA, 2010a), less attention has been paid to the impact of insurance costs on participation rates (MADD Canada, 2012). Even for drivers with a clean record, automobile insurance is generally expensive in Canada,[8] particularly in the nine jurisdictions that do not have public insurance systems.[9] For example, the estimated cost of insurance for a 22-year old with four years' driving experience and a clean record would be $3,065 in Toronto, $2,822 in Calgary, and $1,659 in Halifax (MADD Canada, 2012).

The cost of insurance for impaired driving offenders should not be set at a level that creates a compelling financial incentive to forgo assessment and treatment, drop out of the licensing system, and drive illegally and without insurance. (Scopatz, et al., 2003, p. 30). These unlicensed drivers are much more likely to drive impaired, cause a crash, and attempt to flee the scene. Impaired driving offenders in an interlock program should be offered substantially

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[8] This is partially due to the costs of the mandatory first-party benefits, and the minimum third-party liability coverage of $200,000 required in all jurisdictions, except Quebec ($50,000 of third-party vehicle damage insurance) and Nova Scotia ($500,000 of third-party liability coverage). The Insurance Bureau of Canada also attributes the high costs of insurance to rising personal injury damages, hidden legal fees, for-profit personal injury clinics, and fraud (Insurance Bureau of Canada, 2013).

[9] The private insurance industry provides coverage in Alberta, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, and the three Territories.

reduced premiums, both as an incentive to participation and as a reflection of the reduced risks they pose while driving an interlock-equipped vehicle.

In Quebec, the province with the highest interlock participation rate, automobile insurance is provided by a public agency (SAAQ). The insurance surcharges for a *Criminal Code* impaired driving conviction are very modest, even for repeat offenders (i.e. $300, $350 and $400 for a first, second and third conviction). Similarly, in British Columbia, which also has a public insurance system, the surcharge for a first offence is $905 for three years (MADD Canada, 2012). In contrast, if the 22-year-olds described above had a single impaired driving conviction, their premiums would increase for three years to roughly $10,000 - $20,000 in Toronto (326% - 653%), $7,500 in Calgary (266%) and $9,000 in Halifax (542%) (MADD Canada, 2012). The relatively high interlock participation rates in these three jurisdictions, despite the high insurance surcharges, requires some explanation.

First, while Ontario's, Alberta's and Nova Scotia's interlock participation rates are <u>relatively</u> high, they are still below 50%. Second, a significant number of interlock participants apparently do not inform their insurer of their conviction, even when asked. Since the companies do not routinely check offence records on an annual basis, these offenders may be able to avoid paying the costly surcharges (Murie, personal communication, May 20, 2013). However, if these offenders knowingly misinform their insurer, their insurance coverage will be largely negated. Their first-party benefits are greatly limited, and their third-party coverage is typically restricted to the provincial minimum. While these offenders may benefit from participating in the interlock program and nominally remain in the licensing system, they expose the public to the risk of injuries and losses for which there is only limited third-party coverage. In any event, significantly more impaired driving offenders would likely enroll in an interlock program and appropriately inform their insurers of their conviction if the insurance surcharges were not prohibitive.

Other factors that may affect interlock participation rates
Several other factors warrant brief mention. All of the provinces have some kind of remedial education or treatment program that must be completed prior to or while participating in the interlock program (Chamberlain & Solomon, 2012, p. 351; MADD Canada, 2013). These programs vary in duration, cost and the criteria for successful "completion" (eg simple attendance, behaviour modification, or a period of "violation free" driving). If these remedial programs are costly and require completion prior to entering the interlock program, some offenders may be reluctant to participate (Voas & Marques, 2003).

Participation rates will also be affected by the availability of interlock service and maintenance providers, and the required inspection schedule. If offenders have to drive long distances on a regular basis to have the interlock inspected and serviced, they will be less likely to participate in and/or successfully complete the program (DeYoung, 2002, p. 480). These factors vary widely both between and within the provinces.

Summary and Conclusions
The preceding review suggests that certain program features and related policies will encourage increased interlock participation rates. Participation tends to be higher if the program is mandatory for all offenders and provides a reduced hard licence suspension as an incentive to participation. More effective licence check programs, vehicle impoundment legislation, and similar measures are needed to discourage offenders from driving illegally. Finally, if the total relicensing costs are unaffordable, due to insurance costs, interlock

installation and maintenance fees, and/or other remedial program charges, large numbers of federal impaired driving offenders will abandon the licensing system, as would appear to be the case in almost every jurisdiction in Canada.

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Appendix

Mandatory Programs: Inclusion Criteria, Suspension Reductions and Duration

Prov./ Terr.[1]	Inclusion Criteria	Reduced Suspension	Minimum Duration		
			1st	2nd	3rd
AB[2]	Any alcohol-related *Criminal Code* impaired driving offence[3]	Yes	1 year[4]	3 years	5 years
BC	Any alcohol-related *Criminal Code* impaired driving offence[5]	No	1 year	2 years	3 years
MB	Any alcohol-related *Criminal Code* impaired driving offence	No	1 year	1 year	3 years[6]
NB	No Mandatory Program.				
NL	No Mandatory Program.				
NT	No Mandatory Program.				
NS	"High-risk first offenders"[7]; drivers convicted of impaired driving causing death or bodily harm[8]; or offenders with a prior impaired driving, failing/ refusing a test or driving while disqualified conviction	Yes	1 year	2 years	3 years
NU	No Interlock Program.				
ON	Any alcohol-related *Criminal Code* impaired driving offence	Yes[9]	1 year	3 years	Life
PE	Impaired driving or failing/refusing a test[10]	Yes	1 year	2 years	5 years
QC[11]	Impaired driving offenders who did not apply or were ineligible for the voluntary program	No	1 year	2 years	3 years
SK	Judges can order offenders convicted of impaired driving or failing/refusing a test to participate in an interlock program	Yes	1 year	2 years	3 years
YK	No Mandatory Program.				

1. In addition to the formal interlock program, the traffic authorities typically have broad discretionary power to impose various terms and conditions on the licence of any driver. This residual power could be used to impose interlock orders on federal impaired driving offenders.
2. The lookback period for a prior conviction is 10 years.
3. The phrase "any alcohol-related *Criminal Code* impaired driving offence" includes all offences in ss. 253, 254 and 255.
4. The Registrar has discretion to refrain from imposing an interlock order on a first offender whose BAC was below .16%.
5. Participation is mandated by administrative policy.
6. The lookback period for prior convictions is 10 years. The prescribed interlock period is the driver's lifetime for a fourth conviction, but a driver can apply to have an interlock order longer than 3 years

removed at the end of the third year.

7. A “high-risk” offender is a driver who has been assessed in an alcohol rehabilitation program as being “high risk.”

8. The minimum participation period for these drivers is 2 years if they are first offenders and 5 years if they are repeat offenders.

9. The reduction only applies to first offenders. Drivers who plead guilty have their licence suspension reduced to a minimum of 3 months, followed by a minimum 9-month interlock order. Drivers who did not plead guilty have their licence suspension reduced to a minimum of 6 months, followed by a minimum 12-month interlock order. No reduction is available to offenders: who were impaired by drugs, or a combination of alcohol & drugs; or who were convicted of impaired driving causing death or bodily harm.

10. In PEI, offenders who are convicted of an offence under s. 255 (impaired causing death or bodily harm; BAC above .08% and causing death or bodily harm; and failing/refusing a test and causing death or bodily harm) are not eligible for the mandatory program.

    The lookback period for a prior conviction is 10 years. If there was a passenger under the age of 16 in the vehicle at the time of the offence, the Registrar may add a further term of up to 12 months to the interlock order for a first, second or third offender.

11. The lookback period for prior convictions is 10 years. The interlock order is 2 years for a first offender who had a BAC above .16% or refused to provide a sample. The order is 3 years for these offenders if they had 1 or more prior cancellations in the preceding 10 years for an alcohol-related offence, unless their BAC exceeded .16% in the prior offence or the offence was for refusing to provide a sample. A lifetime interlock order is imposed on offenders if they had 1 or more cancellations in the preceding 10 years for refusing to provide a sample or for any alcohol-related offence in which their BAC exceeded .16%. A lifetime interlock order is also imposed on drivers with 3 or more alcohol-related impaired driving convictions in the past 10 years.

Developments in Canadian community-based driving initiatives: MADD Canada's "Campaign 911"

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Abstract

Context

Despite numerous federal, provincial and territorial legislative amendments, countless awareness programs and similar initiatives, impairment-related crashes remain the leading criminal cause of death in Canada (Mahony, 2011; Pitel & Solomon, 2013, p. 3). The progress made from the early 1980s until the late 1990s has almost stopped (Mayhew, Beirness & Simpson 2004; Pitel & Solomon, 2013, p. 3). Among other problems, Canada's charge rate for impaired driving offences per licensed driver is relatively low, constituting less than 42% of the American rate as of 2010 (Centers for Disease Control and Prevention, 2012; Office of Highway Policy Information, 2010; Statistics Canada, 2013; Transport Canada, 2012, p. 5).

Various programs have been undertaken in Canada and the United States to encourage the public to report suspected impaired drivers to the police. The elements of these programs have varied, few programs were assessed, and the collected data were incomplete. In 2007, MADD Canada launched its national "Campaign 911"[1] to encourage the public to report suspected impaired drivers. The campaigns were initiated on a local or provincial basis and typically involve a broad coalition of police services, media, municipal officials, and other community partners. MADD Canada is the largest grassroots anti-impaired driving organization in the country. Its more than 100 Chapters and Community Leaders and 7,500 volunteers spread throughout all 13 provinces and territories give MADD Canada's programs considerable reach.

Objectives

To review the pre-existing public mobilization programs, describe the key elements of MADD Canada's Campaign 911 and assess its reported impact.

Key Outcome

The results of MADD Canada's Campaign 911 have been promising. The reported benefits include: increased public awareness of the impaired driving issue; increased public perception of the risk of apprehension; increased public calls to the police regarding suspected impaired drivers; and increased police vehicle interceptions, provincial licence suspensions, federal impaired driving charges, and police follow-up contacts with the owners of reported vehicles that were not intercepted (MADD Canada, 2012, slide 6).

[1] While the national campaign is generally referred to as "Campaign 911," the local programs often go by different names, including the "Call-911 Campaign," the "Curb the Danger Program," and the "Report Impaired Drivers Program."

Discussion and conclusions

The elements of MADD Canada's Campaign 911 are consistent with the research on effective media, traffic safety and multi-component community campaigns (Babor et al, 2010, pp. 156-158, 200-202, 207-210; Elder et al, 2004; Phillips, Ulleberg & Vaa, 2011; Schults et al, 2009). Similarly, the focus on increasing police interception and charge rates is consistent with deterrence theory (Beck, Fell & Yan, 2009; Homel, 1986; Homel, 1993, p. 59; Nagin, 1998; Tay, 2005; Watson & Freeman, 2007). However, the individual campaigns were initiated on a local level, and the specific features, intensity and duration vary. Moreover, the data on the individual campaigns have not been collected and reported on a consistent basis. Nevertheless, given the promising results to date, MADD Canada's Campaign 911 warrants a systematic review.

Introduction

MADD Canada's Campaign 911 is not novel in that the public has been reporting suspected impaired drivers since the establishment of the first police emergency call systems. Virtually all jurisdictions now have a single dedicated phone number, such as 911, to receive calls from the public for emergency services. Typically, the number is linked to a call centre with specially trained staff who assess and prioritize the calls and, where appropriate, dispatch the police, fire department and/or emergency medical services. The widespread use of cell phones has greatly increased the public's capacity to report incidents in a timely manner.

MADD Canada's Campaign 911 and similar programs focusing on impaired and dangerous driving build on this existing infrastructure and the widespread use of cell phones. Campaign 911 seeks to increase public awareness of: the impaired driving issue; the public's role in detecting and apprehending suspected impaired drivers; the appropriateness of calling 911 to report suspected impaired drivers; how to make reports safely; and the information that should be reported. In turn, these measures should increase the number of public calls, the relevance of the information reported, the number of suspects intercepted, and the number of provincial licence suspensions and criminal charges. In addition to the immediate removal of impaired drivers from the roads, Campaign 911 seeks to deter impaired driving by increasing the perceived risk of apprehension.

The pre-existing American and Canadian programs

There have been a number of initiatives in the United States to encourage and support the reporting of suspected impaired drivers to the police. For example, the National Transportation Safety Board included "Citizen Reporting" in its 1989 recommendations to the state governments. In 2005, Congress directed the National Highway Traffic Safety Administration (NHTSA) to prepare a detailed study on implementing a statewide program for reporting suspected drunk drivers (Fiorentino, Cure, & Kipper, 2007, p. 1).

In 2007, NHTSA published the results of a survey on the programs for reporting suspected impaired drivers in 57 American states and territories. Of the 53 jurisdictions that responded, 45 had a reporting program using the general emergency number, and six had a reporting program with a dedicated emergency number (Fiorentino, Cure, & Kipper, 2007, p. 2). In most cases, the public reports were directed to the appropriate police agency regardless of whether the jurisdiction had a general emergency number or a dedicated number. Unfortunately, most of the states and territories simply noted that they had a reporting program and only answered a few additional questions, leaving the majority of the survey unanswered.

Nevertheless, there were some trends in the responses. Most jurisdictions promoted their programs using some combination of billboards, highway signs, patrol cars, television, and radio. The most common problems cited were: too few patrol cars to respond to calls; inadequate or incomplete information provided by callers; and the length of time it took to find the reported vehicle. Other concerns included the lack of probable cause to stop the reported vehicle and inappropriate calls. Only Colorado, Idaho and Washington reported that their programs had been evaluated. However, the results of the evaluation were unknown in Colorado and dated in Idaho. Washington indicated that its program had resulted in an increase in arrests and a decrease in fatalities (Fiorentino, Cure, & Kipper, 2007, pp. 5-52).

The NHTSA study also sought detailed information on the impact of the specific programs, but again the data reported were very limited. For example, only seven jurisdictions provided information on three or more of the following questions, and only two jurisdictions provided information on all five questions (Fiorentino, Cure, & Kipper, 2007, pp. 53-62):

- How often is a patrol vehicle actually dispatched?
- Average time between call and stoppage of vehicle?
- Estimated percentage of calls resulting in arrest?
- Estimated percentage of calls resulting in prosecution?
- Estimated percentage of calls resulting in conviction?

In Canada, programs to encourage the public to report suspected impaired drivers are also popular. For example, a program called “Operation Lookout” began in the late 1980s and was sponsored by a series of Ontario community-based impaired driving groups. In 2006, the Ontario Community Council on Impaired Driving (OCCID), a charitable organization, assumed responsibility for Operation Lookout (Leonard, slide 3). The program components typically included road signs, billboards, signs in businesses, PSAs, and ads in newspapers. The program provided additional information on how to identify a suspected impaired driver and on what information should be reported (Purnell, 2008, p. 6). Community groups have run Operation Lookout in approximately 50 Ontario cities, towns and counties. As in the United States, little information is available on the features, intensity or duration of the individual Operation Lookout initiatives.

Although OCCID suggests that Operation Lookout has had significant traffic safety benefits, little supporting evidence is provided (Leonard, slides 2 and 14). A presentation on the Belleville area Operation Lookout program at the 2008 OCCID Countermeasures Conference set out the number of provincial licence suspensions and impaired driving arrests from 2000 to 2005, but did not indicate if or how this information related to the program (Jianopoulos, 2008, slide 5). A 2007 Grey Bruce Health Unit press release stated that public reports to the police concerning suspected impaired drivers increased 71% since the 2000 launch of the local Operation Lookout program (Grey Bruce Health Unit, 2007). A 1995 Peel Regional Police memorandum indicated that public calls reporting suspected impaired drivers increased by 70% and that impaired driving incidents had decreased by 36% following the 1992 introduction of Operation Lookout (Peel Regional Police, 1995, p. 5).

The authors have been unable to find any other information on whether the Operation Lookout programs, either individually or collectively, increased public calls to the police. Nor is there information on whether the programs increased the number of police interceptions of suspected impaired drivers, provincial licence suspensions or criminal charges.

MADD Canada's Campaign 911

Campaign 911 is described as a community partnership involving traffic safety organizations, the police, emergency call centres, public health units, insurance companies, municipalities, and the media. The national police partners include the Canadian Association of Police Boards, Canadian Police Association and Canadian Association of Chiefs of Police. Campaigns have been initiated in communities in Newfoundland and Labrador, Ontario, British Columbia, New Brunswick, and the Yukon, and there are province-wide Campaigns in Prince Edward Island, Nova Scotia, Manitoba, Saskatchewan, and Alberta. In total, approximately 60 Campaign 911 programs, albeit sometimes using a different name, are currently operating in cities, towns and communities across Canada (Kelly, 2013, pp. 3-4).

MADD Canada has released a detailed guide on how to establish an effective Campaign 911 program, delineating the key responsibilities of the police, emergency call centres and community partners. The guide specifically addresses the need for the police and emergency call centres to coordinate their activities and ensure that sufficient resources are allocated to address the anticipated increase in calls concerning suspected impaired drivers (MADD Canada, 2012, slides 9 and 11). The guide also emphasizes the importance of engaging and educating the public to maximize the number of helpful calls and the importance of large, high-visibility roadside signs and ongoing media initiatives (MADD Canada, 2012, slides 7-8). The appendix to the guide includes sample road signs, billboards, promotional materials, press releases, and other resources.

The key police responsibilities include: participating in the program launch; responding to media and public inquiries; preparing media releases; redeploying resources; responding to 911 calls and intercepting reported vehicles; and, where appropriate, issuing provincial licence suspensions, laying criminal charges and following up with the owners of reported vehicles that were not intercepted. The police are also asked to collect statistics on the Call-911 program, including: the number of 911 calls received; the number of calls that result in the police being dispatched; the number of vehicles intercepted; the number of provincial licence suspensions, criminal charges and convictions; and the number of follow-up letters and visits to the owners of reported vehicles that were not intercepted (MADD Canada, 2012, slides 9-10).

The responsibilities of the community partners include: promoting the program to the public; undertaking media campaigns; raising funds for 911 billboards and road signs; and educating the public (MADD Canada, 2012, slide 12). One of the initial tasks is to convince the public that suspected impaired driving constitutes an emergency that warrants calling 911. The MADD Canada guide refers to surveys indicating that 50% of Canadians felt that it was inappropriate to use the 911 emergency number to report a suspected impaired driver (MADD Canada, 2012, slide 4). The guide also includes educational materials for the public on 10 signs of suspected impaired driving and specific instructions on how to call safely (MADD Canada, 2012, slides 13-14). The public is advised to: keep the calls short; report their location, the vehicle make, model, colour, plate number, and direction of travel; and provide a description of the driver (MADD Canada, 2012, slide 15).

Unlike the American study and the Operation Lookout program, there is considerable information on the impact of at least some of the Campaign 911 programs. Moreover, most of the information is current to 2010 or 2011, and includes two of Canada's largest municipalities. However, there is only statistical information on nine of the programs, and the type of data reported varies. For example, in Saskatoon, Regina, Camrose, and Edmonton, the information is limited to the post-implementation period. In other cases, information is available on the number of pre and post-implementation calls, and the resulting police interceptions, provincial licence suspensions, criminal charges, and follow-up actions concerning vehicles that were not intercepted.

In the 12 months following the initiation of the program in Saskatoon (pop. 231,900) in 2010, the public made almost 3,000 calls to 911 concerning suspected impaired driving. The police intercepted 616 of the reported vehicles, and these police stops resulted in 240 provincial licence suspensions and criminal charges. The police also sent warning letters to the owners of 1,121 vehicles that had been reported but not intercepted (MADD Canada, 2012, slides 23-24).

Edmonton (pop. 730,000) initiated its Campaign 911 program in 2007. It generated 9,229 calls in 2010, which led to 3,392 vehicle interceptions, 1,174 provincial licence suspensions and criminal charges, and 1,192 follow-up letters to the owners of reported vehicles that were not intercepted (MADD Canada, 2012, slides 25-26). While calls (7,852), suspensions and criminal charges (969), and follow-up letters (584) declined in 2012 (Edmonton Police Service, 2013), the January to March 2013 statistics are somewhat more positive (Kelly, 2013, p. 5). In its first eight months beginning in October 2010, the Camrose (pop. 17,200) program received 192 calls, resulting in 101 vehicle interceptions, 34 provincial licence suspensions and criminal charges, and 23 follow-up letters to the owners of reported vehicles that were not intercepted (MADD Canada, 2012, slides 29-30).

Following the York Regional Municipality's implementation of the program in 2006/07, the average annual number of 911 calls about suspected impaired driving and resulting criminal charges increased by 59% and 81%, respectively (MADD Canada, 2012, slides19-20). In the year after the 2008/09 launch of Calgary's program, 911 calls concerning impaired drivers and resulting criminal charges rose by 80% and 28%, respectively (MADD Canada, 2012, slide 22).

In Ottawa, 911 calls reporting suspected impaired drivers increased by 43% following the December 2009 implementation of the program (MADD Canada, 2012, slide 28). In Nanaimo, the 2009 launch of the program was credited with increasing 911 calls concerning suspected impaired driving by 110% and resulting provincial licence suspensions and criminal charges by 100% and 33%, respectively (Kelly, 2013, p. 2). In the year following the 2011 launch of the Brandon campaign, total calls (911 and general police number) concerning impaired driving suspects increased 47%, vehicle interceptions increased 79%, and provincial licence suspensions and criminal charges increased 48% (Kelly, 2013, pp. 10-11).

Conclusion

MADD Canada's Campaign 911 is not novel, but it appears to be comprehensive, integrated and well resourced. It is currently operational in more and larger communities than Operation Lookout, which is mostly confined to Ontario. Campaign 911 is consistent with the research on effective media, traffic safety and multi-component community campaigns. It stresses the importance of using high-visibility signs, undertaking ongoing intensive promotional activities, educating and mobilizing the public, establishing partnerships with senior police officials, and building broad community coalitions. In accordance with deterrence theory, Campaign 911 focuses on increasing the number of vehicle interceptions, provincial licence suspensions, impaired driving charges, and police follow-up contacts with the owners of reported vehicles that were not intercepted.

Following implementation of the Campaign 911 programs, the number of public calls regarding suspected impaired drivers sharply increased, as did the number of resulting vehicle interceptions, provincial licence suspensions, criminal charges, and police follow-up actions. The large highway signs and related promotional initiatives have likely increased public awareness of the impaired driving issue and the public's perception of the risk of apprehension. Similarly, the increases in vehicle interceptions, provincial licence suspensions, criminal charges, and police warning letters have probably had a deterrent impact.

However, there is statistical information on only nine of the approximately 60 Campaign 911 programs and, of these, only five include pre and post-implementation data. Moreover, the statistics in these five campaigns have not been collected and reported in a consistent manner. As indicated, the programs are initiated on a local level, and there is little information on their specific features, intensity, costs, and duration. Most of the Campaign 911 programs are relatively new, and it cannot be assumed that their current impact will be sustained.

While the information on Campaign 911 is limited, the results to date have been promising. Consequently, in our view, MADD Canada's Campaign 911 warrants a systematic review.

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Reforming Canada's new drug-impaired driving law: The need for per se limits and random roadside screening

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Abstract

Context
The issue of drug-impaired driving has recently risen to prominence in Canada. Survey data, roadside screening studies and post-mortem reports indicate that driving after drug use is commonplace and is now more prevalent among young people than driving after drinking. Although drug-impaired driving has been a criminal offence since 1925, police were not given specific means of enforcing the law until 2008. Unfortunately, the 2008 *Criminal Code* amendments, which authorized police to demand Standardized Field Sobriety Tests and Drug Recognition Evaluations, have not had their desired effects. The measures have proved to be costly, time-consuming and cumbersome, and are readily susceptible to challenge in the courts. Accordingly, the charge rates for drug-impaired driving remain extremely low.

Objectives
To review alternative enforcement models for drug-impaired driving that have been adopted in other jurisdictions, and to recommend a model that will improve apprehension and conviction rates and thereby deter drug-impaired driving. The model must be consistent with Canada's social, political and constitutional frameworks.

Key Outcomes
Canada should adopt a system of random roadside saliva screening, similar to the model used in Victoria, Australia. For drivers who test positive, more sensitive evidentiary testing should be conducted at a police station, after the driver has been afforded the right to counsel.

Discussion and conclusions
The 2008 *Criminal Code* amendments were an important first step, but will not significantly improve apprehension or conviction rates for drug-impaired driving. It is preferable to set *per se* limits for the most commonly-used drugs, enforceable through a system of screening and evidentiary tests. This will be more efficient and cost-effective, and will result in more reliable evidence for criminal trials. Although this system will inevitably be subject to constitutional challenge, existing case law suggests that it should be upheld as a reasonable limit on constitutional rights.

Introduction
Drug-impaired driving is an issue that warrants serious attention in Canada. Driving after drug use has become more common during the past 15 years (Mann et al., 2010; Simpson, Singhal, Vanlaar, & Mayhew, 2006). Perhaps of greatest concern, several provincial, regional and national surveys indicate that many young people routinely drive after drug use (Asbridge, Poulin, & Donato, 2007; Patton, Mackay, & Broszeit, 2005; Poulin & McDonald, 2007). Indeed, more young Canadians report driving after using cannabis than after drinking (Paglia-Boak, Adlaf, & Mann, 2011, p. 15). For example, in the *Canadian Addiction Survey*, 39.8% of those aged 15-24 reported driving within two hours of using cannabis during the past 12 months, compared to 20.9% who reported driving under the influence of alcohol (Canada, Minister of Health, 2007, p. 95). In addition, the mean number of times that

respondents admitted to driving "under the influence of cannabis" in the past year was 10, compared to 1.6 for alcohol.

These survey data are reaffirmed by roadside surveys (Brault, Dussault, Bouchard, & Lemire, 2004; Beirness & Beasley, 2011) and post-mortem toxicology tests (Mercer & Jeffrey, 1995; Bouchard & Brault, 2004). For example, a 2011 study involving almost 6,000 drivers who were fatally injured from 2000 to 2007 found that 54.6% were positive for alcohol and/or drugs (Beasley, Beirness, & Porath-Waller, 2011, p. 1). Alcohol alone was present in 21.9% of the cases, drugs alone were present in 18.5%, and alcohol and drugs were present in 14.2%. In the drug-positive cases, 41% were positive for two or more drugs (p. 10). The high rates of concurrent drug and alcohol use and of poly-drug use are troubling because these substances' combined effects may be multiplicative. Thus, it seems clear that drug-impaired driving merits legislative attention.

Prior to the 2008 *Criminal Code* amendments, the prosecution of drug-impaired driving cases was typically based on the arresting officer's testimony regarding the accused's driving, behaviour, demeanor, and statements. However, even when an accused was obviously impaired, and there was evidence of recent drug use, it was typically still necessary to bring expert evidence linking the drug use to the accused's impairment. As one judge remarked, "the preferred practice [is] for the Crown to call expert medical or scientific evidence regarding the effects of drugs.... the court cannot take judicial notice of the effects of various drugs" (*R v Rosskoph*, para. 18). This made drug-impaired driving an onerous and uncertain offence to prosecute. Indeed, a 2003 Department of Justice report indicated that prosecuting a drug-impaired driving offence based on the observations of a non-expert police officer (such as one on routine patrol) was "nearly impossible" (Department of Justice, 2003, p. 4).

The 2008 *Criminal Code* amendments

The difficulties in prosecuting drug-impaired driving offences prompted Parliament to introduce two new enforcement measures in 2008. First, police are authorized to demand a Standardized Field Sobriety Test (SFST) if they reasonably suspect that a driver has any alcohol or drugs in his or her body. This is a relatively low threshold test, which is based on the same grounds as the demand for breath tests on approved screening devices (ASDs). As with ASD tests, the results of SFSTs can only be used to screen drivers at roadside and to provide grounds for demanding subsequent evidentiary breath tests or Drug Recognition Evaluation (DRE).

Second, the 2008 amendments established formal procedures for gathering evidence of drug use and impairment from suspected drug-impaired drivers. They authorized police to demand a DRE from a driver who they have reasonable grounds to believe has, within the preceding three hours, driven while impaired by a drug or a combination of drugs and alcohol. The results of the DRE are admissible at trial, if the DRE was conducted in accordance with the requirements of the relevant regulations and the driver was afforded the right to counsel.

Developed and used in the United States since the 1970s, DRE is designed to determine if an individual's ability to drive is impaired by one of seven categories of drugs.[1] The *Criminal Code* provides that DREs can only be conducted by an "evaluating officer," who must be accredited by the International Association of Chiefs of Police. The process of training,

[1] The seven categories of drugs are: central nervous system depressants; inhalants; dissociative anesthetics; cannabis; central nervous system stimulants; hallucinogens; and narcotic analgesics.

certifying and maintaining the certification of evaluating officers is rigorous and expensive. It was estimated that the cost of training each evaluating officer in Canada is $17,000, and that a total of 800 officers have been trained. However, with transfers and retirements, there were only 491 evaluating officers conducting DREs as of September 2012.[2]

DRE consists of several physiological and divided attention tests, at the conclusion of which the evaluating officer completes a written opinion as to whether the suspect's ability to drive is impaired and, if so, by what category of drugs. The officer can then demand a sample of blood, urine or saliva for analysis. A drug-impaired driving charge will only proceed to trial if the bodily sample confirms the evaluating officer's conclusions. It has been reported that a typical DRE in Canada lasts 30-45 minutes, and entails the collection of over 100 separate pieces of information (Porath-Waller, Beirness, & Beasley, 2009, p. 517).[3]

While DRE may be accurate in identifying drug-positive suspects, it is of far less value in proving that the suspect's driving ability was in fact impaired by drugs. Most of the steps in the DRE focus on drug presence and not on the impairment of driving ability.[4] Unfortunately, there are no studies on the relationship between failing a DRE and actual impairment of driving skills, as measured by laboratory, driving simulator, and closed access roadway tests. This problem has not gone unnoticed by the Canadian courts.

DRE in the Canadian courts

The Canadian courts remain sceptical about the link between the mere presence of drugs in a driver's system and the actual impairment of driving ability. In a recent Saskatchewan case (*R v Perillat*), the investigating officer smelled an "overwhelming odour" of marijuana coming from the accused's vehicle. The accused admitted to smoking marijuana 2½ hours earlier, and showed the officer the "roach" on her centre console. The results of both the SFST and DRE were indicative of marijuana use, which was confirmed by a urine test. However, at the accused's trial for impaired driving, the judge was not convinced that her ability to drive was actually *impaired* by marijuana. The judge explained:

> But at its best, Constable Schaefer's evidence convinces me that the accused had used marijuana at some point prior to her being stopped at the police check stop that evening and that she still had some of it in her system at the time he did his Drug Recognition Evaluation on her at the police station. What his evidence does not convince me of is that at the time she was driving, her ability to operate a motor vehicle was impaired by marijuana.
>
> …
>
> Constable Schafer's evidence does not explain the accused's test results and how they relate to the accused's ability to drive a motor vehicle or how they relate back to the time of driving. Without testimony on these points, I am left with many questions. For example, what signs of impairment would one expect to see in someone who has been using marijuana? How long after using marijuana would you expect to see these signs and how long would they last? Can the results of Drug Recognition Evaluation tests taken over one and one-half hours after the time of driving be reliably related back to the time the accused pulled into the check stop? Was the accused's performance in some of the tests just as consistent with someone who has poor balance or poor co-ordination as it was with someone who had used marijuana? (*R v Perillat*, paras. 24, 26)

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[2] Email communication from D Beirness, Senior Research and Policy Analyst, CCSA, to A Murie, CEO, MADD Canada (24 September 2012).

[3] This does not include the time necessary to conduct the preliminary roadside SFST, transport the suspect to the police station, or allow him or her to consult with counsel. When these aspects are included, the process takes close to two hours from testing to completion.

[4] It is only the four divided attention tests (the walk-and-turn, the one-leg-stand, the Romberg balance, and the finger-to-nose tests) that directly assess the impairment of skills thought to be important for driving.

In acquitting the accused, the judge also stressed the absence of any evidence that the accused had been driving in an erratic, improper or impaired manner.

Criminal Justice Statistics
Even with approximately 500 officers conducting DREs, the number of persons charged with a drug-impaired driving offence has been disappointing. There were 944 drug-impaired driving charges in 2011, which constituted only 1.4% of all impaired driving charges (60,414) (Statistics Canada, 2013). While the total number of persons charged with a drug-impaired driving offence increased by almost 15% from 2009 to 2010, it increased by less than 4% from 2010 to 2011. This means that only a tiny percentage of drug-impaired drivers are ever charged. The Canadian Centre for Substance Abuse has estimated that drivers make 15.6 million trips per year after using cannabis (CCSA, online). Even if all 944 drug-impaired driving charges involved cannabis, a driver would have had to make more than 16,500 trips after using cannabis to have been charged with a single drug-impaired driving offence.[5]

Alternatives to DRE
In addition to the behavioural-based enforcement approach used in Canada, drug use can be detected through the testing of blood, saliva or urine. Ideally, the testing protocol for drugs would parallel the existing *Criminal Code* breath-testing provisions for alcohol. That is, preliminary screening would be conducted at roadside, with further evidential testing conducted at the police station after the accused has been afforded the right to counsel. However, testing for drug impairment is more complex than testing for alcohol impairment. First, not all drugs necessarily or consistently cause impairment. Second, the non-active metabolites of some drugs stay in a driver's system long after their impairing effects have worn off. Third, until recently, there was no quick, inexpensive and non-invasive means of screening drivers for drug use at roadside. Finally, while there is a broad consensus on the impairing impact of alcohol at various BAC levels, views differ regarding the specific level at which the various drugs impair driving ability. Consequently, the scheme for enforcing alcohol-impaired driving cannot simply be adopted for drug-impaired driving.

Zero tolerance and per se limits
Other jurisdictions have approached this problem in two main ways. In some jurisdictions, it is an offence to drive with any amount of a specified drug in one's system (the "zero tolerance" approach). At least a dozen American states have adopted this approach (Lacey, Brainard, & Snitow, 2010). When combined with chemical testing, zero tolerance laws have been shown to increase charge rates for drug-impaired driving. Both police and prosecutors report that zero tolerance laws have made it easier to prosecute drug-impaired driving cases. These laws provide a clear and unambiguous message, and can be enforced objectively by police without extensive specialized training. However, a zero tolerance approach may not garner much public or political support in Canada, given that drivers may test positive for a drug even though their ability is not impaired. In addition, a zero tolerance law may be perceived as a back-door attack on drug use, rather than a drug-impaired driving measure.

Given the potentially negative policy implications of a zero tolerance law in Canada, the preferable alternative is to establish criminal *per se* limits for given drugs, at a level at which the driving ability of most drivers would be impaired. This approach allows the government

[5] Admittedly, these 15.6 million trips include people who were not impaired by cannabis at the time of driving. However, it excludes those who were impaired by other drugs.

to focus on the drugs that are most commonly used, most likely to cause impairment, and that can be detected at roadside by means of a relatively quick and inexpensive test.

Enforcing per se limits

It is not enough to prohibit driving with a set amount of drugs in one's body. As with alcohol-impaired driving, the police need the authority and means to conduct toxicological drug tests on drivers. Considering other demands on criminal justice resources, police need enforcement procedures that are straightforward and cost-effective, but nevertheless constitutionally valid. In some jurisdictions, toxicological tests are conducted in a relatively small number of cases. For instance, although Arizona has a zero tolerance law, the likelihood of a driver being chemically tested for drugs is minimal (Lacey et al, 2010). Police must have probable cause to stop the vehicle and have grounds to initiate a drug-impaired driving investigation.[6] This is a protracted and exacting process, and depends heavily on the officer's personal observations. Such a system is unlikely to dramatically increase drug-impaired driving charges.

In contrast, several European countries (Beirness, Swan, & Logan, 2010) and Australian states have introduced random roadside screening for specified drugs. In these jurisdictions, the police typically have authority to demand that any driver take a saliva test at roadside. If the driver tests positive, he or she will then be required to undergo additional, evidentiary testing. Like random breath testing (RBT), which also exists in these jurisdictions, random drug screening allows the police to test a large number of drivers in a relatively short period of time. For drivers who test negative, there is only a modest delay and slight inconvenience.

The Australian state of Victoria provides a useful model for Canada. The *Road Safety (Drugs Driving) Act, 2003* and *Road Safety (Drugs) Act, 2006* prohibit drivers from operating a motor vehicle with any level of methamphetamine, THC or MDMA (ecstasy) in their systems. The legislation authorizes police to randomly demand an oral fluid screening test from any driver at roadside. If the driver tests positive for any of the target drugs, he or she is required to accompany police to a testing vehicle where a second saliva sample is taken. The second sample is tested by a specially trained and qualified police officer. If the second sample also tests positive for a targeted drug, it is sent to a laboratory for confirmatory analysis, and the driver is immediately prohibited from driving for a specified time. The driver will only be charged if the laboratory analysis confirms the presence of a targeted drug. If the second test is negative, the driver will be released, after a total detention of approximately 15 minutes. Preliminary analysis of Victoria's drug-testing framework has shown positive results. All 489 drivers prosecuted pursuant to the legislation between December 2004 and December 2006 were convicted (Boorman & Owens, 2009, p. 21).[7]

Nevertheless, the approach in Victoria would need to be modified to be consistent with Canada's legal and social framework. First, as described, a zero tolerance approach is likely to be seen as back-door enforcement of the federal drug offences, and would capture drivers who are not actually impaired by the drug while driving. Consequently, *per se* limits would need to be established. Second, Canadian police are not generally equipped with roadside testing vehicles, so suspected drug-impaired drivers would need to be taken to a police station for further evidentiary testing. Moreover, drivers would need to be informed of and allowed to exercise their constitutional right to legal counsel before evidentiary testing took place. Finally, the current Canadian law does not allow for the random roadside screening of drivers

[6] The driver must exhibit visible signs of impairment but have a low BAC, thereby ruling out alcohol as the source of impairment; or there must be other obvious signs of recent drug use (eg drug paraphernalia).
[7] Another 17 were convicted of refusing to provide a sample.

for either alcohol or drugs.[8] The authors have repeatedly called for RBT legislation (Solomon, Chamberlain, Abdoullaeva, Tinholt & Chiodo, 2011a; Solomon, Chamberlain, Abdoullaeva, & Tinholt, 2011b), and do not repeat those arguments here. The case for random drug screening is as compelling as the case for RBT. Indeed, there may be less opposition to drug screening than to RBT, given that it would target drugs that are already being used illegally.

Constitutional Issues

Like most changes to enforcement practices, the random stopping of drivers and random saliva screening for drugs will undoubtedly give rise to challenges under the *Canadian Charter of Rights and Freedoms*. The most likely challenges would be based on section 9 (arbitrary detention), section 10(*b*) (the right to counsel), and section 8 (unreasonable search or seizure). As we have explained elsewhere, random toxicological screening will undoubtedly be found to be arbitrary and a violation of the right to counsel (Solomon et al, 2011a). However, consistent with the Supreme Court's decisions regarding roadside ASD testing and SFST, these drug-related violations should be justified under section 1 of the *Charter* as reasonable limits "prescribed by law [that] can be demonstrably justified in a free and democratic society"[9] (*R v Hufsky*; *R v Ladouceur*; *R v Thomsen*; *R v Orbanski*).

There is somewhat less certainty as to whether random saliva screening would violate the right to be free from unreasonable search and seizure. This will depend on whether drivers have a reasonable expectation of privacy with respect to saliva testing. While there is undoubtedly some expectation of privacy, this expectation is qualified given that driving is a licensed activity that involves considerable risk and requires that one's ability to drive not be impaired (*R v Wise*). Further, providing a saliva sample at roadside is minimally intrusive. The test does not involve pain, discomfort or indignity, and reveals no personal information about the driver except for the presence of certain drugs in his or her system. The test is used solely for screening purposes and is not admissible in criminal proceedings. When put in the context of the random screening procedures used at every Canadian airport, at border crossings, at many courts and other government facilities, which commonly involve physical searches of one's person and luggage, we believe that random roadside saliva testing should be found to be a reasonable search under the *Charter* (Chamberlain, Solomon & Kus, 2013).

Conclusion

The sharp increases in drug-impaired driving pose a major traffic safety risk in Canada, particularly for young drivers. Although the enactment of SFST and DRE legislation gave police authority to investigate drug-impaired driving, it has proven to be inadequate. Thus, the federal government should move from its exclusive reliance on SFST and DRE, and work toward enacting a system of roadside saliva testing for the most commonly-used illicit drugs. The accuracy and affordability of the drug screening tests will likely continue to improve and Canada should take advantage of these advances. Once sufficient scientific consensus has been reached, Canada should enact appropriate *per se* limits that are akin to the .05% and .08% BAC limits for drinking and driving.

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[8] In order to demand a breath test on an ASD or SFST, police must reasonably suspect that a driver has alcohol or drugs in his or her body. *Criminal Code*, section 254(2).

[9] The test for justifying *Charter* violations is set out in *R v Oakes*, [1986] 1 *Supreme Court Reports* 103. It involves five elements. (i) Is the infringement prescribed by law? (ii) Does it respond to a pressing and substantial legislative objective? (iii) Is the measure rationally connected to the objective? (iv) Does it infringe *Charter* rights as little as possible? (v) Do its positive effects outweigh its deleterious effects?

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Developments in Canadian Community-Based Impaired Driving Initiatives: The Ontario "Last-Drink" Program

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Abstract

Context
A disproportionate number of impaired drivers are coming from licensed establishments, as opposed to their own home or other private venues. Despite Canada's stringent liquor licence legislation, licensed establishments routinely over-serve patrons, many of whom subsequently drive. In the absence of far more rigorous enforcement, licensed venues have little incentive to comply with the legal prohibitions against serving intoxicated patrons.

"Last Drink" programs focus liquor licensing enforcement on high-risk establishments in an attempt to reduce impaired driving and other alcohol-related incidents. Pursuant to the program, the police ask impaired driving suspects where they had been drinking. If a licensed establishment is named, the information is forwarded to licensing officials for follow-up action.

Objectives
This paper outlines the rationale for implementing Last Drink programs and summarizes the limited research on their impact. It describes Ontario's mandatory Last Drink program, which was introduced in August 2012, and the preliminary results of the pilot project on which it was based. Finally, the paper puts this program into the broader framework of regulating the hospitality industry.

Key Outcomes
A large percentage of the impaired driving suspects in the Ontario pilot project reported coming from a small percentage of the licensed establishments. The Alcohol and Gaming Commission of Ontario (AGCO) described the program's preliminary results as "encouraging on multiple fronts," and Mothers Against Drunk Driving (MADD) Canada and other safety organizations endorsed it. Ontario subsequently introduced a mandatory province-wide Last Drink program.

Discussion and conclusions
Last Drink programs appear to temporarily improve serving practices in the targeted venues. However, it is unclear if these initiatives have a lasting impact on the targeted establishments and the broader hospitality industry. Nor is there much evidence on the ongoing impact of these programs on the incidence of impaired driving.

Introduction
While licensed venues account for approximately 20% of total alcohol consumption in Canada (Babor et al., 2010, pg. 32), they play a disproportionate role in terms of the impaired drivers apprehended by police. A similar pattern is evident in the United States and Australia. For example, one study reported that between one-third and three-quarters of the intoxicated drivers

stopped by police in the United States had their last drink at a licensed establishment (Stewart & Sweedler, 2007, pg. 4), while another American study put the figure at up to 50% (Moore, 2007, pg. 177). In New South Wales, approximately 50% of impaired driving offenders had been drinking in a licensed premise prior to the offence (Rydon, Stockwell, Syed, & Jenkins, 1993, pg. 339). Not surprisingly, licensed establishments are similarly overrepresented in alcohol-related crashes (Willingham & Mosher, 2013, slide 31).

An early Ontario roadside survey reported that while only 6% of the drivers were coming from bars or taverns, they accounted for 16% of the drivers with BACs between .05% – .08%, and 16% of those with BACs above .08% (Single & McKenzie, 1992, pg. 3).[1] In a 2001 Alberta nighttime roadside study, drivers coming from bars and taverns were 5 times more likely to be legally impaired than drivers coming from all other locations (Belton, Voaklander, MacDonald, & Jhangri, 2001, pg. 3). Similar results were evident in the 2003, 2008 and 2010 British Columbia roadside surveys (Beirness, Foss, Wilson, & Burch, 2004; Beirness & Beasley, 2010; Beirness & Beasley, 2011). In the 2010 survey, 8.4% of drivers coming from bars, pubs and nightclubs had BACs above .08%, compared to 2.2% of total drivers (Beirness & Beasley, 2011, pg. 9 & 12).[2]

Binge drinking (i.e. consuming five or more standard drinks in a single sitting), which strongly correlates with impaired driving, is commonplace in licensed establishments, particularly bars and taverns (Rydon et al., 1993; Rammohan et al., 2011, pg. 335). Canadian research indicates that the environment in bars and clubs predisposes students to heavy drinking (Demers, Kairouz, Adlaf, Gliksman, Newton-Taylor, & Merchand, 2002). Indeed, Canadian university students report that they routinely binge drink when at a bar or pub, consuming on average 5.1 drinks (Centre for Addiction and Mental Health [CAMH], 2005, pg. 37 & 42).

Enforcing Liquor Licence Legislation

Given the preceding statistics, it is evident that licensed establishments, particularly bars, pubs, taverns, and nightclubs can play an important role in reducing impaired driving. It has long been illegal in Canada for licensed establishments to sell, serve or provide alcohol to patrons who are or appear to be intoxicated, or to permit "drunkenness" on the premises.[3] These stringent prohibitions can be traced back, at least in Ontario, to colonial times and remain subject to potentially severe penalties.[4] Moreover, even in the absence of a charge, licensing officials have broad administrative authority to suspend, revoke or refuse to renew a licence if the licensee has breached any provision of the liquor legislation or its regulations, or any condition of the

[1] Drivers coming from licensed restaurants were not overrepresented in terms of drivers with BACs between .05% – .08%, and above .08% (Single & McKenzie, 1992, pg. 3).

[2] In the 2008 British Columbia roadside survey, 26.1% of the drivers coming from pubs/bars had a BAC above .08% (Beirness & Beasley, 2010, pg. 218-219).

[3] Ontario, *Licences to Sell Liquor*, R.R.O. 1990, Reg. 719, s. 45(1). See also Nova Scotia, *Liquor Control Act*, R.S. c. 260, s. 95(a), (b) and (c) (*LCA*); and British Columbia, *Liquor Control and Licensing Act*, R.S.B.C. 1996, c. 267, s. 43(1) and (2) (*LCLA*).

[4] See for example, Ontario, *Liquor Licence Act*, R.S.O. 1990, c. L.19, s. 61 (*LLA*); Nova Scotia, *LCA*, ss. 78 and 103; and British Columbia, *LCLA*, s. 48(2) and (3).

licence.[5] Finally, the police and liquor licence inspectors are authorized to enter and search any licensed premises without a warrant. While on the premises, they may demand documentation and seize evidence of any offence.[6] Licensing officials clearly have broad investigatory powers and ample legal authority to ensure compliance with the legislation.

Some studies indicate that increased enforcement in licensed establishments reduces the number of over-served patrons and the number of impaired drivers originating from these venues.[7] In a Michigan study, increased enforcement focused on targeted establishments significantly reduced the number of "'pseudopatrons' simulating intoxication" who were served and the percentage of impaired drivers coming from these establishments (McKnight & Streff, 1994). A Swedish project involving enhanced licensing and police enforcement increased the rate at which service was denied to intoxicated patrons from 5% in 1996 to 47% in 1999, and then to 70% in 2001 (Wallin, Nörstrom, & Andreasson, 2003, pg. 275; Wallin, Lindewald, & Andreasson, 2004, pg. 409).[8] Moreover, crimes in the intervention area fell an estimated 29% compared to a slight increase in the control area (Wallin et al., 2003, pg. 274). The project also included training in responsible beverage service and conflict resolution (Wallin et al., 2004, pg. 409).

Other studies on the impact of enhanced enforcement are more equivocal. For example, one study stated that "targeted responsible beverage service programs combined with enforcement may have an impact on traffic safety" (Stewart & Sweedler, 2007, pg. 5). Another study reported that "while enhanced regulation and enforcement are key components of alcohol policy, they cannot be relied on to prevent all, or even most, problems" (Mann et al., 2009, pg. 12). In a recent review, the Task Force on Community Preventive Services concluded that "there is insufficient evidence to determine the effectiveness of over-service law enforcement initiatives as a means to reduce excessive alcohol consumption and alcohol-related harms, because of the small number of available studies and inconsistent findings" (Task Force on Community Preventive Services, 2011, pg. 345).

The alcohol industry and others have suggested various alternatives to enhanced enforcement, such as self-regulation of marketing, industry accords and industry-sponsored responsible consumption campaigns. These measures have either proven to be ineffective or there is little evidence of their efficacy (Babor et al., 2010, pg. 159-162; Anderson, Chisholm, & Fuhr, 2009, pg. 2237-2239; Giesbrecht, 2000; Dejong, Atkin, & Wallack, 1992). While some research indicates that responsible beverage service programs have a positive effect, particularly when coupled with intensive enforcement (Stockwell, 2001, pg. 260; National Highway Traffic Safety Administration [NHTSA], 2013, pg. 1-46 & 1-47), other studies have not found these programs

[5] Ontario, *LLA*, s. 15(1). See also Nova Scotia, *LCA*, s. 47(1), (3) and (4); and British Columbia, *LCLA*, ss. 16, 16.1, and 20(1)(a), (c.1) and (2)(c)-(e).

[6] See for example, Ontario, *LLA*, ss. 44(1) and 47(1) and (1.1); Nova Scotia, *LCA*, ss. 109(1), 111(1), and 113; and British Columbia, *LCLA*, s. 67(1) and (2).

[7] Research also indicates that increased enforcement reduces sales to minors and alcohol-related violence. See for example, NHTSA, 2012; Wallin, Lindewald, & Andreasson, 2004; and Hughes, Furness, Jones, & Bellis, 2010.

[8] This large, multi-component initiative (Stockholm Prevents Alcohol and Drug Problems) was launched in 1996. Its success has been attributed to the strong support of its group members, the long-term commitment to the project and the ongoing positive media support that it has received (Babor et al, 2010, pg. 155).

to be effective (Ker & Chinnock, 2006; Ker & Chinnock, 2008; Hughes, Furness, Jones, & Bellis, 2010, pg. 10-12).

Last Drink Programs

A. Introduction

Last Drink programs can be designed to address various alcohol-related problems stemming from licensed establishments, including alcohol-related violence and impaired driving. The programs seek to improve serving practices in establishments that appear to generate a disproportionate share of the problems. Police calls for service are used to identify high-risk licensed establishments for enhanced enforcement. For example, when the police apprehend an impaired driver, they ask the driver where he or she had been drinking. If the driver identifies a specific venue, that information is passed on to the licensing authorities for follow-up action. This may range from issuing a warning letter and targeting the establishment for increased visits by police and regulatory officials, to taking disciplinary action. These measures serve to encourage or force licensed establishments to improve their serving practices (Sim, Morgan, & Batchelor, 2005).

B. The International Experience

There is limited research on the effectiveness of Last Drink programs. While there are some positive results in terms of the immediate effects of these programs, their lasting impact on hospitality industry practices and impaired driving remains to be determined.

Two American studies have reported positive short-term results. Washtenaw County, Michigan, initiated a Last Drink initiative in 1990. Enforcement was increased for 12 months, with half of the enforcement concentrated on the 10 licensed establishments responsible for the greatest number of intoxicated drivers. The rate at which "'pseudopatrons' simulating intoxication" were refused service rose from 17.5% to 54.3% in the first three months, but then fell to 41.0% at the end of 12 months (McKnight & Streff, 1994, pg. 82).[9] The percentage of suspects arrested for impaired driving who reported coming from licensed establishments, fell from 31.7% to 23.3% one year after the increased enforcement initiative began. This percentage remained largely unchanged in three comparison counties (pg. 83).

A study was conducted to assess the impact of intensified enforcement on Washington State's Last Drink program. The authors reported that the period of intensified enforcement had "mixed" results (NHTSA, 2008, pg. 4).[10] Although the authors detected no change in retail practices, there were two promising findings. First, the monthly average number of impaired driving arrestees who reported coming from a targeted venue decreased 36% following the intensive enforcement period (pg. 9). The comparable decrease in the non-targeted (control) venues was 7% (pg. 9). Second, the average BAC of arrestees originating from targeted establishments

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[9] The refusal rate in a neighbouring county also increased, but to a lesser extent (McKnight & Streff, 1994, pg. 83). The significance of this finding is unclear, because of the potential spillover effect that the Last Drink program had outside of county boundaries.

[10] Moreover, the authors stated that the results should be viewed with caution, given the small number of licensed establishments involved (NHTSA, 2008, pg. 4).

decreased from .135% to .127%, while there was a modest increase in the control establishments (pg. 11).

In the mid-1990s, New South Wales began implementing the "Alcohol Linking Program," which required the police to determine whether suspects arrested for any offence had been drinking. If so, the police recorded the suspect's level of intoxication and where the suspect had his or her last drink. If a licensed venue was involved, the suspect was asked for its name and location. The police subsequently followed up with the establishment to encourage greater compliance with the legislation (Wiggers et al., 2004). A 2002 – 2003 study reported that 10% of the establishments accounted for 50% of the people involved in police-attended incidents arising from licensed venues. Following the adoption of an enhanced enforcement program, the number of intoxicated individuals coming from licensed venues who were arrested for an alcohol-related crime fell by up to 22%. The enhanced program involved more intensive enforcement, an audit of the establishment's serving practices, individualized recommendations, and police follow up (pg. 360). This study did not address the impact of the program on impaired driving.

Wellington, New Zealand implemented an enforcement program based on Last Drink information and police intelligence. A study was undertaken to assess the impact of increasing the regular level of intervention during two six-week periods. The authors reported that enhancing police and licensing enforcement in licensed establishments "may have contributed to a reduction in the number of highly intoxicated persons" (Sim et al., 2005, pg. ii-iii). During the periods of intensified enforcement, there were decreases in disorder offences and, to a lesser extent, violent offences (pg. 58). Again, the study did not address the impact of the intensified enforcement program on impaired driving.

C. The Canadian Experience

The police and licensing authorities in Ontario have strongly endorsed Last Drink initiatives. In response to "unacceptably high" rates of impaired driving in the early 1990s, the Peel Regional Police began analyzing background data on these offenders and found that up to 46% may have been drinking in licensed premises (Peel Regional Police, 1996, pg. 3). They used these data to identify high-risk establishments and induce them to improve their practices. In addition to warning the venues and offering training on identifying intoxicated patrons, enforcement in the area was intensified.

The Ontario licensing authorities teamed up with the police in what became known as the "Last Drink Campaign." Licensees named by intoxicated suspects were subject to closer scrutiny and progressive disciplinary action, which included sending licensees advisory letters and reference materials, conducting full investigations and initiating disciplinary action (pg. 4).. In praising the program, both the police and licensing authorities noted that it allowed them to more efficiently use their resources and enforce the liquor law (pg. 4). However, the program was not formally assessed. Nor did the police provide data on whether the program reduced the overall incidence of impaired driving in the region or the percentage of impaired drivers coming from licensed establishments. Only one statement was made in this regard, namely: 19 impaired driving arrestees reported coming from a particular venue, and this number fell by 50% once the Last Drink program was fully implemented (pg. 4-5). While this was cited as an achievement, one could draw the opposite conclusion and question why this venue still had a liquor licence.

Several municipal police departments and the AGCO launched a large Last Drink pilot project from July 1, 2011 to January 1, 2012. During this period, 3.6% (7 of the 196) of the identified licensed establishments accounted for 26.5% of the suspects who were arrested for a federal impaired driving offence or who were subject to a provincial administrative licence suspension for having a BAC between .05% – .08% (O'Halloran, 2012, slide 8).[11] The establishments that were named were subject to escalating AGCO intervention.[12] Moreover, 22 establishments were added to the AGCO's "Risk-Based Enforcement List," which resulted in increased inspections (slide 9). As with the Peel "Last Drink Campaign," the police and licensing officials enthusiastically endorsed the project but provided no data on its impact.

Based on the pilot project, the Ontario Chiefs of Police and the AGCO introduced a mandatory province-wide Last Drink program. As of August 6, 2012, all police were required to report to the AGCO any death or serious injury that could be linked to alcohol consumption in a licensed establishment or at a licensed event, including non-traffic-related deaths. The police were also encouraged to report to the AGCO any alcohol-related offence, such as impaired driving and public intoxication, which could be linked to an identified licensee (AGCO, 2012).

Conclusions

In Canada, a disproportionate share of impaired drivers apprehended by the police are coming from licensed premises, with much of the problem attributable to a small number of high-risk licensees. Last Drink programs are designed to identify these high-risk venues and subject them to increased scrutiny and enforcement. The limited research to date suggests that Last Drink programs can temporarily reduce service of alcohol to apparently intoxicated patrons and the number of impaired drivers leaving targeted establishments. It remains to be determined whether these positive results are due to the Last Drink program itself or to the intensive enforcement that accompanies it. Nor is it clear if Last Drink programs have an ongoing impact on the targeted venues, the broader hospitality industry or the incidence of impaired driving. While Last Drink programs have intrinsic appeal, the critical issue appears to be whether the police and licensing authorities are willing to use their broad enforcement authority to compel compliance.

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[11] The numbers reported in the presentation are inconsistent. Consequently, the numbers reported on slide 8 and 11 cannot be reconciled with those on other slides.

[12] On a first report, a liquor inspector meets with the licensee to inform him or her of the incident. On a second report, an inspector meets with the licensee and reviews the prohibitions against permitting drunkenness and over-serving patrons. On a third report, an inspector meets with the licensee, and explains that the venue is being placed on the Risk-Based Enforcement List and will be subject to increased inspections. Moreover, a formal warning letter is sent to the licensee.

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When Science Meets Policy: Co-Construction of Decision Making

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Abstract

Context

The legislation in the province of Québec stipulates that a driver's license is a privilege that drivers can be deprived if they are determined to represent a road safety risk. Until June 2012, only *convicted* DWI offenders were assessed to evaluate such risk. This delayed procedure was deemed insufficient. Accordingly, the Société d'assurance automobile du Québec, Québec's licensing authority, introduced a change in their procedures. They introduced an assessment procedure to identify elevated risk for DWI recidivism *upon arrest* for drivers who had: 1) a blood alcohol concentration equal or superior to 160mg%; 2) a previous conviction for DWI within the last 10 years; 3) a refusal to provide a breath sample.

This strategy did not eliminate a more fundamental shortcoming. The validity of prediction of DWI risk in first-time arrested drivers is inconclusive in the current state of knowledge. To palliate these limitations, the SAAQ assembled a Working Group composed of: 1) the coordinator of the current assessment program and her assistant; 2) three scientists experienced in prediction of DWI recidivism; 3) two clinicians experienced in the assessment of convicted DWI offenders; 4) a highly qualified research professional; 5) professionals of the research unit of the SAAQ.

Objectives

This presentation will describe the iterative and interactive processes that took place within the Working Group to pragmatically address a complex multidimensional public health challenge. The process was an exemplary case of transdisciplinary co-construction: different stakeholders contributed to the final protocol by sharing their diverse but complementary knowledge base.

Discussion and conclusions

In retrospect, given the limitations of current knowledge and the urgency to increase road safety, the decision to combine tacit and empirical knowledge is innovative and may warrant replication. An objective analysis of the effectiveness of the resulting assessment protocol is currently underway.

Integrated knowledge transfer

This paper describes the iterative and interactive processes that took place between regulators, clinical evaluators and scientists to pragmatically address a road safety issue: the development of an assessment to test a driver's ability to dissociate drinking from driving a road vehicle. We report on what we consider a success story of integrated knowledge transfer by which a group of concerned actors were dynamically engaged in the task put before them. The result was considered sufficiently comprehensive, clinically valid, and legally defensible to be integrated in the legislation on road safety of the Province of Québec, Canada, put in force in July 2012.

A collaborative approach

Increasing road safety is a challenge. A web of factors including law, policy, alcohol and drug use availability and marketing, and individual socio-economic, physical and mental health, and cognitive factors are at play. Scientific evidence can help face some of the challenges if bridges are built between regulators, clinicians, and researchers. The translation of scientific findings to policy can be accelerated when several winning conditions are put in place in the early development of a transdisciplinary research program. Among these conditions are: the involvement from the start of regulators and other key actors who all express their key concerns; a shared decision by all partners to choose evidence-based solutions to manage the road safety problems under study; a research program oriented towards solutions (CIHR, 2013). In such a collaborative setting, a back-and-forth or reciprocal long-term relationship between the actors needs to be put in place so that scientists are receptive to the priorities expressed by the regulators who, in return, take into account the stringent requirements and the limitations that the scientific method imposes on their queries and their solutions. All the actors need to take into account that building mutual trust is a process that takes time: patience is needed since both the research process and the policy changes are lengthy. In short, integrated knowledge transfer in road safety is a long term project, a partnership with frustrations that, if successful, brings great satisfaction to all: the scientists see their work having measurable positive impact on people's lives, while licensing authorities can orchestrate legislation and sanctions imposed on intoxicated drivers that are evidence based and effective in fulfilling their mandate for maximizing traffic safety.

The *CIHR Team in transdisciplinary studies in DWI onset, persistence, prevention and treatment* addresses detection and intervention in individuals who misuse alcohol and drugs and engage in risky driving behaviour, such as driving while impaired. Its objectives are to better understand the multiple pathways to why some individuals repeatedly drive while impaired (DWI) by alcohol, drugs and other conditions (e.g., fatigue). In addition to the licensing authorities and the program responsible for the assessment of convicted drivers (i.e., knowledge users), membership now includes traffic safety experts, psychologists, neuroscientists, biologists, physicians, psychiatrists, and epidemiologists (quotation of latest interview).

From the start, when the first two authors of this paper started a research collaboration, the licensing authorities - the Société de l'assurance automobile du Québec (SAAQ) - contributed to the success of the first studies by helping to set up a large representative sample of DWI offenders (Brown et al, 2005; Ouimet et al, 2007; Brown et al, 2008). The SAAQ is a public corporation that comes under the authority of Québec's Minister for Transport. It offers an integrated management model that applies to three areas: prevention, enforcement and compensation. The CIHR Team collaborates with the research team in road safety responsible for the behaviors related to alcohol and drugs. In addition, the reader should know that drivers found guilty of impaired driving in Québec must provide the SAAQ with an assessment report demonstrating that there is no incompatibility between their behavior with respect to alcohol and drug use and the safe operation of a motor vehicle. This assessment report must be provided by a certified evaluator of the Association des centres de réadaptation en dépendence du Québec, referred to herein as the assessment program (ACRDQ, 2013). During the first decade of the CIHR team, at the request of our partners, our team tackled specific problems linked to the assessment of a convicted driver's alcohol or drug use as these consumption patterns related to the safe operation of a motor vehicle. It was through these successive research projects that: 1) trust was fostered between our team and the licensing authorities and the coordinator of the assessment program resulting in our team having access to more meaningful, but confidential, administrative data; 2) positive results generated from our published studies found concrete applications; and 3) existing problems found evidence based solutions in making informed process changes.

The evaluation of the risk of DWI recidivism: the problematic area

DWI behaviour is relatively rare, but a core group of repeat offenders disproportionately contributes to the overall rates of crashes and injuries. At the turn of the current decade, DWI statistics indicated that after two decades of gradual reductions, current rates had stabilised. In an attempt to reduce morbidity and injury linked to impaired driving, the licensing authorities – SAAQ - were examining effective strategies within their jurisdiction. A provision in the Highway Safety Code stipulates that a driver’s license is a privilege of which one may be deprived if a driving risk is established. Such a provision in the law presented an opportunity to intervene occur prior to criminal prosecution, circumventing the inevitable and often purposeful delays associated with legal procedures. A decision was made to increase the control over drivers who had: 1) a blood alcohol level equal or superior to 160mg/100 m; 2) a blood-alcohol level above 80 mg/100 m and a previous conviction for DWI within the last 10 years; and 3) refused to obey a peace officer by providing a breath sample. The licensing authorities turned to our research team to develop an evidence-informed assessment protocol to evaluate for the risk of DWI recidivism. Our team, now enlarged with a road safety epidemiologist and public health scientist (Dr Junaid Bhatti), responded positively to our partner’s request.

The validity of prediction of DWI risk is inconclusive in the current state of knowledge. Several methodological, analytic and conceptual concerns vex the DWI prediction research. There are methodological challenges, particularly the bias to individual data gathered in an authoritarian evaluation context that evokes fear in drivers of the potential legal, social and economic consequences that frank admission to excessive drinking or other DWI-associated behaviours may engender. In addition, documented arrests, convictions and crashes related to DWI neither reflect all the drink-driving episodes that occur nor are they free from the influence of enforcement practices, geography and other external factors. Our partnership with the provincial licensing authorities had allowed our team to address some of these latter shortcomings in preliminary work with administrative databases. It is important to underscore that though we were in full agreement with the objectives of the licensing authorities, we as scientists remained cognisant of the other complex challenges left unresolved in the task put before us.

The creation of a working group

There is a growing consensus that resolving complex public health problems necessitates research that is cross disciplinary. The research into the high-risk driver problem has been trapped in a conceptual silo where certain behavioural theories and methodologies have dominated. For example, the focus on substance misuse and static personality traits in research that relies on subjective paper-and-pencil questionnaires has yielded consistent associations with high-risk driving. In contrast, our team found that many DWI recidivists show neuropsychological signs of difficulties in changing well-established behaviours, devising plans and following through, resisting the temptation of immediate gains despite the risk of greater losses later on, and learning from past experience (Brown et al, 2008; Maldonado et al, 2012; Ouimet et al, 2007). With these facts in mind, the working group was formed. It was composed of: 1) the coordinator of program responsible for the assessment of convicted drivers (C. Beaumont) and her assistant who had the task of coordinating the work; 2) the three first authors of this paper who had been examining risk prediction for a decade and were responsible for insuring the integrity of the scientific process; 3) two clinicians experienced in the assessment of convicted DWI offenders who brought to the discussion how their clients behaved during the assessment, i.e., real-world clinical situations, and put forth the limitations they had experienced in their practice in the assessment of convicted drivers; 4) a highly qualified research professional mandated to review the necessary evidence, with particular attention to the psychometric qualities of tests, who exposed to the group the strengths and limitations of the assessment measures; 5) two professionals of the research unit of the licensing authority (J. Courtemanche and S. Mercier) who were aware of the legal constraints in which the new assessment had to be framed. The Timelines of the working group are described in Table 1.

Table 1. Timelines

	Activity	Description
August	Working group created	The Research Officer of the SAAQ
September	Formal communication	The members are appointed
October	First meeting	The challenges are identified
November	Second meeting	The review of the literature is discussed
December	Final meeting	Decisions are made
January	Draft of changes sent	Group members respond to draft
March	Approved by SAAQ	Sent to the Minister of Transport
July 1, 2013	Protocol put in place	Data collected to be analysed

The working process

This report on the working process of the group expresses the views of the authors. As we experienced it, the group effort was directed at achieving its goal within a time limit: the work had to be terminated by June 2012. There was a shared understanding that, first, all group members bring to the task a unique perspective that was indispensable to reach its goal, and second, successful group processes involve taking into account the contribution of each member. In general, group members were receptive to the task information from others and, in return, incorporated the given information into the reflection and exchanges that followed.

The reason for this equalitarian group-oriented behaviour, with opinion seeking and general discussions, may be attributed to the power structure in the group. The group was lead by the coordinator of the current assessment program for convicted DWI offenders. She was the interface between all the group members and was not in a position of authority inside or outside the group: she was a broker in both situations. She acted as a group facilitator, for which she had experience (she is a licensed clinician), and remained task oriented. She wanted the group to reach its goal within the time framework. The representatives of the licensing authority understood more than the rest of the group members the legal constraints of the task put before the group: they had been on the forefront of the inevitable legal challenges directed towards the SAAQ. Their contribution kept the group's deliberations within a pragmatic framework, specifically the need to meet current legal standards. The research professional was a young Ph.D. who not only had a passion the subject under study, but also was well trained in psychometrics. He was thus able to communicate clearly to the group the limits of the scientific evidence. The two clinicians had been chosen for the quality of their work and the depth of their tacit knowledge accumulated over a decade of assessing convicted DWI offenders. Their real-world perspective grounded the discussions, particularly when the group had to make difficult choices that were not readily informed by science. The three scientists brought to the group their expertise and fund of empirical knowledge. They had had access to confidential databanks, had analysed them, and knew the strengths and weaknesses of the assessment developed for the convicted DWI offenders. They also had comprehensive knowledge of the literature, as well as the results of the various research projects conducted by the research team. Their expertise and knowledge advanced the objective appraisal of current protocols, and provided direction as to what adaptations were likely to be advantageous. Most and foremost, the common attribute shared by all group members was a trusting attitude that had been built during the preceding decade.

In the end, there was a sense that the group had reached a consensus in arriving at the decisions that were ultimately made. There were moments when differences in opinion between group members were substantive, which inevitably reflected the distinctiveness between members in background, training, and experience. Nevertheless, on the whole there was a general receptiveness to the input of all group members and a democratic approach to problem solving.

Limitations

There was neither an outside observer nor any valid qualitative analysis of the group processes described above. As a result, this report lacks objectivity to some degree. There may have been a stronger implicit hierarchical structure than perceived and described by the authors. As a result, the group status structure may have influenced the decision-making process more than reported in this paper. One cannot also exclude the possibility that there was an increased reliance on certain group members to make final decisions.

Conclusion

In retrospect, given the limitations of current knowledge and the urgency to increase road safety, the decision to combine tacit and empirical knowledge is innovative and may warrant replication. It is our opinion that long term collaboration between the regulators, clinical evaluators and scientists made a significant difference in decision regarding this road safety issue. Working groups without a history of successful joint ventures may not report such a positive experience. As far as the working group processes are concerned, the cooperative exchanges among group members were probably facilitated because: i) a definite deadline had to be respected, ii) all group members were aware that the current state of knowledge in the prediction of DWI risk was inconclusive – no one had the universal answer to the task under study; and iii) all adhered to the overarching objective of serving the public good. All members of the group actively participated throughout the process, increasing the sentiment that there was a joint equalitarian effort to reach the common goal.

An objective analysis of the effectiveness of the resulting assessment protocol is currently underway. The result will provide objective feed back on the choices that were made by the working group.

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Relationship of Latent Profiles from the RIA Self Inventory with Various Outcomes

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Abstract

Recently Robert Mann and his colleagues, using a Canadian sample, performed a factor analysis on the RIA Self Inventory (RIASI), a screening instrument developed for use with DUI offenders. Results showed differential relationships of the eight identified factors with various outcomes. The current study was designed to confirm the factor structure of the RIASI in a sample from the United States and then to assess whether specific profiles could be identified that would help in development of intervention strategies. Subjects were referred to the Research Institute on Addictions (RIA) for clinical evaluation. As part of that process, the DUI offenders were extended an offer to participate in this research project. Of the 765 individuals referred to the RIA from various courts in the Western New York area, 549 agreed to participate in the study, with 520 having valid data. The assessment included alcohol and other drug use and problems, abstinence self-efficacy, psychiatric distress, hostility, family history, readiness to change, and the RIASI. An 18-month follow-up was also conducted, with driver records obtained. **C**onfirmatory factor analysis on the RIASI showed a relatively good fit: Root Mean Square Error of Approximation (RMSEA) = .018; Comparative Fit Index (CFI) = .95; Tucker-Lewis Index (TLI) = .95. Indications for the latent class analyses based on the subdimensions of the RIASI indicated the most optimum solution was for 4 classes. There were significant associations of the profiles with alcohol problems, drug problems, alcohol expectancies, abstinence self-efficacy, psychiatric distress, hostility, and treatment entry (all p's < .05) but not for recidivism. The results indicate that the RIASI has reliable underlying dimensions that can be used to identify subgroups of offenders. Differences in the subgroups can lead to more effective intervention development and use.

Background

The rate of fatal crashes involving alcohol in the United States has somewhat stabilized around 32% (NHTSA, 2010). Arrests for DUI have also been relatively stable with approximately 1.4 million arrests per year. Furthermore, the percentage of those individuals arrested who are repeat offenders has also been relatively stable at around 33% (BJS, 2012). The stability of the fatal crash rates involving alcohol and the arrests rates and percentage of repeat offenders, suggests a need for alternative or additions to the sanctions currently being used.

Nochajski and Stasiewicz (2006) point out that there has been a push towards more reliance on rehabilitation services, with rehabilitation covering psycho-education and standard abstinence based treatment, as well as brief and harm reduction interventions. In their meta-analysis of interventions for DUI offenders, Wells-Parker et al. (1995) found that treatment and education programs had only a modest impact (7-9% reduction in recidivism rates). The authors also found that combinations of psycho-education and treatment with more broadly defined goals than just abstinence as having the largest impacts on recidivism.

Treatment matching has also been suggested. The idea is to basically identify needs and match the person with the appropriate treatment. One critical issue is to be able to identify needs in a way that is feasible for treatment organizations.

As an initial step in that process, Mann and his colleagues (2009), using a Canadian sample, identified sub-dimensions in the RIA Self-Inventory (RIASI) that showed differential relationships to subsequent drinking and drug use outcomes. This suggests that scores in the sub-dimensions may have some potential to be used for identifying treatment needs.

Aims

The current study set out to assess whether the factor structure for the RIASI identified by Mann et al. (2009) could be replicated in a sample of DUI offenders from the United States. Additionally, we were interested in determining if specific profiles could be identified as a function of the sub-dimensions in the RIASI. If such classes can be identified, there would be some potential for matching interventions based on the profiles.

Methods

Subjects

Participants were referred by various courts in the Western New York area to the RIA for clinical assessments as part of their sanctions. Of the 765 individuals referred to the RIA from various courts in the Western New York area, 549 agreed to participate in the study (72%). However, due to issues with a research assistant 29 cases were dropped. Of the remaining 520 individuals, 443 (85%) completed the 18-month follow-up interview.

Procedures

Upon arrival at the RIA, potential participants were provided an explanation of the study and given the choice of completing their evaluation as part of the research project or choosing another provider. If the person agreed to participate they signed the consent and release forms allowing us to provide information back to the courts. In addition they agreed to provide access to their Department of Motor Vehicle records to allow for assessment of recidivism. This study was approved by the institutional review board of the University at Buffalo.

Measures

The assessment included alcohol and other drug use and problems, abstinence self-efficacy, alcohol expectancies, psychiatric distress, hostility, and the RIASI. An eighteen-month follow-up using the same measures was also conducted, with driver records obtained, allowing for assessment of recidivism.

The Research Institute on Addictions Self Inventory (RIASI; Nochajski, 2006 unpublished manual) consists of 52 items that assess a variety of proximal and distal characteristics that are highly correlated with alcohol problems, or drug problems, or DUI recidivism. Identified subscales from this measure were used to identify profiles/classes of DUI offenders.

Substance Use Problem Severity was assessed using the Alcohol Dependence Scale (ADS; Skinner & Allen, 1982; Skinner & Horn, 1984), the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993), and the Drinker Inventory of

Consequences (DRINC; Miller, Tonigan, and Longabaugh, 1995). The total scores from the three aforementioned scales were standardized and then summed together to create an index of overall problem severity. The reliability coefficient for this index was .86.

Drug Problems were assessed using the Drug Abuse Screening Test (DAST; Skinner, 1982). This is a brief measure for drug involvement that includes 20 items. The reliability coefficient for this scale was .82.

The Timeline Follow-back (TLFB; Sobell & Sobell, 1992; 1996) was used to collect drinking and drinking-driving information, as well as drug use information, for the 30-day period prior to each interview. Measures derived from the alcohol TLFB included: Number of days drinking, total number of drinks, number of days drinking-driving, number of days drinking 5 or more drinks, and maximum number of drinks in one day. These five measures were log-transformed and then summed together to create an index of alcohol use. For these five measures the alpha coefficient was .88.

The drug measure consisted of the number of days using drugs, number of days drugged-driving, number of days using multiple drugs, and number of days driving after using multiple drugs. These measures were log-transformed due to skewness. The log transformed variables were then summed together. The alpha coefficient for these four items was .62.

Participants were asked to rate statements on how alcohol affects them, using the Alcohol Effects Questionnaire (as modified by Rohsenow, 1983). For the current study the total scale score was used, with a reliability coefficient of .97.

The Abstinence Self-Efficacy Scale (AASE; DiClemente, Carbonari, Montgomery, & Hughes, 1994) was used to assess confidence levels for remaining abstinent across 20 situations. The alpha coefficient for these 20 items was .95.

The Symptom Checklist-90 Revised (SCL-90-R: Derogatis, 1994) was used to assess psychiatric distress, with an alpha coefficient .95.

The State-Trait Anger Expression Inventory (STAXI; Spielberger and Reheiser, 2004) was used to assess hostility/anger of the participant. Three measures from this inventory were used: state anger; trait anger; and the anger index. The Alpha coefficients ranged from .718 to .918.

Data Analyses

Initial analyses focused on confirming the factor structure of the RIASI that Mann and colleagues identified in a sample of Canadian DWI offenders. MPlus was used for this purpose. Chi-Square, Root Mean Square Error of Approximation; Comparative Fit Index; and the Tucker-Lewis Index were used to assess fit of the model. Mplus was then used to determine if the dimensions of the RIASI could be used to identify classes of DWI offenders. Latent Growth Mixed Modeling was used for this purpose. The next set of analyses were then focused on determining if the classes were differentially related to 18- month outcomes (alcohol problems, alcohol use, drug problems, drug use, alcohol expectancies, alcohol abstinence self-efficacy, psychiatric distress, hostility, treatment entry, and recidivism.

Results

The sample was mostly male (77%), White (91%), had greater than a high school education (65%), and were never married (61%), with a mean age of 33. In addition, 33% were repeat offenders, 31% refused the breath test, and the mean BAC for those who provided a breath test was 0.162. Finally, 29% met criteria for an alcohol diagnosis and only 10% met criteria for a drug diagnosis.

The results for the confirmatory factor analysis on the RIASI showed a relatively good fit after allowing some residuals to correlate. These were within the identified subdimensions. While the Chi-Square was significant, χ^2 =1155.77, df = 988, other fit indices were in the acceptable area: Root Mean Square Error of Approximation (RMSEA) = .018; Comparative Fit Index (CFI) = .95; and Tucker-Lewis Index (TLI) = .95. The factors were then used to identify classes of DWI offenders. The most optimum number of classes from the analyses was 4. These are shown in Figure 1. As can be seen the 4 profiles show distinguishable patterns across the eight identified dimensions of the RIASI, social desirability, negative affect, sensation seeking, alcohol consumption, alcohol problems, hi-risk behaviour, and family history for alcohol problems. Class 1 shows low to moderate risk across all dimensions. Class 2 is high on social desirability, high-risk and family history with moderately high mean item probabilities on all other dimensions. Class 3 shows a high mean item probability on social desirability with lower mean item probabilities for all other dimensions. This appeared to be the lowest risk group. Class 4 showed higher mean item probabilities for social desirability, sensation seeking, and alcohol consumption. Classes 2 and four appear to be more problematic.

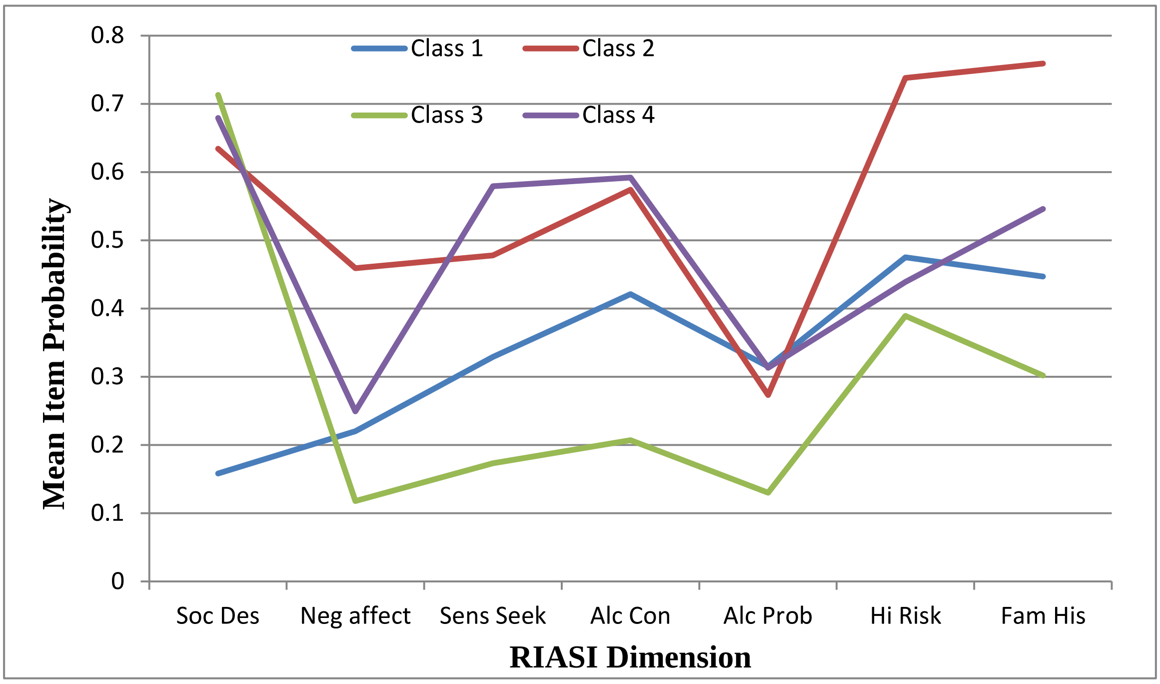

Figure 1. RIASI Dimensions By Class

After a Bonferoni adjustment, the profiles indicated in Figure 1 showed significant associations with alcohol problems, drug problems, alcohol expectancies, abstinence self-efficacy, psychiatric distress, hostility, and treatment entry (see Table 1). Class 1 did not show highest means for any of the outcomes; however, it was close on drug use and hostility. In contrast, class 2 showed highest means for alcohol problems, hostility, and psychiatric distress, with the highest percentage entering treatment. Class three was lowest on all measures. Class 4 showed the highest means for drug use and drug problems, as well as alcohol use and alcohol expectancies.

Discussion and Conclusions

The results for the confirmatory factor analysis suggest some stability in the RIASI underlying dimensions. The fit for the United States sample indicates that the underlying meaning of the various components of the RIASI can be replicated. Perhaps more importantly they suggest potential for identifying areas that may need to be addressed by any intervention being assigned to the offender.

The results for the profile analysis are a little more complex. They suggest it is possible to identify profiles based on the sub-dimensions of the RIASI. However, there is a strong need to replicate these findings. Nonetheless, the results do show that useful information concerning intervention use and development. From a treatment matching approach, the profiles may identify specific areas that need to be addressed with any intervention used with a certain profile.

Table 1. 18-Month Outcomes as a Function of Class

Variable	Class 1 n = 19	Class 2 n = 48	Class 3 n = 289	Class 4 n = 87	Sig.
Drug Problems	.109 (.348)	.366 (.686)	.178 (.492)	**.524 (.770)**	$p < .001$
Drug Use	.466 (1.26)	.375 (1.19)	.123 (0.57)	**.486 (1.09)**	$p < .001$
Alcohol Problems	-.375 (1.56)	**1.14 (3.53)**	-.437 (2.48)	.902 (2.77)	$p < .001$
Alcohol Use	-.067 (2.42)	.157 (3.53)	-.245 (2.08)	**.735 (2.98)**	$p = .014$
AEQ	86.79 (27.78)	92.74 (36.99)	78.52 (26.54)	**94.76 (29.95)**	$p < .001$
Alc Abst Self-efficacy	79.79 (15.32)	74.91 (15.92)	**82.84 (12.74)**	75.56 (14.11)	$p < .001$
Hostility	**1.69 (2.96)**	**1.77 (3.70)**	-.721 (2.44)	1.07 (3.09)	$p < .001$
Psychiatric Distress	24.16 (24.31)	**37.53 (34.98)**	14.28 (20.83)	27.19 (25.67)	$p < .001$
Treatment entry	36.8%	**58.3%**	12.1%	39.1%	$p < .001$
Recidivism	26.3%	**33.9%**	28.0%	**33.7%**	NS

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Responsibility for non-fatal collision with blood alcohol concentration less than 0.05%

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Abstract

Background
In Victoria, motorists taken to hospital after a motor vehicle collision are required to provide a sample of blood for analysis. In a study of 1809 drivers injured in collision, 487 drivers (27% of the total) tested positive for alcohol.

Aim
This study aimed to test the hypotheses that low blood alcohol concentrations are associated with significant increase in responsibility for collision.

Methods
Collision data and toxicology was available from 1809 collisions were the driver was taken to hospital. Collision data was subject to responsibility analysis.

Results
47 drivers had a blood alcohol concentration less than 0.05% (mean 0.033%). 36 were responsible for the collision, 8 contributed and 3 were not responsible for the collision. These drivers with low blood alcohol concentration were 7.7 times more likely to have been responsible for the collision than drivers who had not been drinking. 82% of these collisions involved another vehicle.

Discussion and conclusions
These results support zero tolerance for alcohol. There is no rational reason to consider blood alcohol concentrations below 0.05% as 'safe'.

Introduction

Driving under the influence (DUI) of intoxicating liquor has been an offence in Victoria since 1909. In 1955 the Crimes (Driving Offences) Act (Victoria 1955) included a presumption that if the blood alcohol concentration was less than 0.05% the driver was unimpaired. Breath analysis was introduced in 1961. It became an offence for a driver to have a blood alcohol concentration greater than 0.05% in 1966 (Boorman 1999). There is an implication that impairment starts at 0.05%. This paper refutes that assumption.

Aims

This study aimed to test the hypotheses that blood alcohol concentrations less than 0.05% increase the relative responsibility for collision in which the driver is injured.

Methods

A person over the age of 15 years, who is taken to hospital following a motor vehicle collision is required to furnish a sample of blood for analysis (Victoria 1986). The sample is divided into three aliquots: a ‘screening’ sample, a ‘patient’ sample which is given to the patient and an ‘evidential’ sample which is stored for formal analysis and potential prosecution. The screening sample was used for this study.

The first 936 samples were screened by Victorian Forensic Sciences Centre (VFSC). Subsequent blood samples (n=1801) were screened at the Victorian Institute of Forensic Medicine (VIFM). Both services are accredited by the National Association of Testing Authorities in the provision of Toxicology for Forensic Science (ISO/IEC 17025:2005)

935 samples were excluded because sample was not from a driver (i.e. pedestrian or passenger), the driver had not been injured in a collision, the collision was deliberate (driver had attempted suicide), the driver had died within 30 days due to injuries sustained in the collision, or there was insufficient information in the collision report to perform the responsibility analysis.

Toxicology results were matched against collision details by Victoria Police personnel. There is no link between this data and health records, so it is not possible to identify therapeutic agents such morphine which were legitimately administered as part of pre-hospital or urgent hospital care.

Analysis of responsibility for collision was carried out using the method developed by Robertson and Drummer (Robertson and Drummer 1994). A value between 1 and 4 is assigned to eight factors which might explain the collision: road condition, vehicle condition, driving conditions, collision type, witness observations, compliance with road laws, task difficulty and level of driver fatigue. The higher the value given, the more the extenuating factors are likely to have contributed to the collision. A driver with a low aggregate low score (score <13) is judged to be ‘responsible’ for the collision, a driver with a mid-range score (≥13 and ≤15) is defined as ‘contributing’ to the collision, and a driver with a high score (>15) is deemed to be ‘not responsible’ for the collision. Responsibility analysis was carried out blinded to knowledge of the toxicology results to avoid expectant bias.

The control sample (n=954) was the group of drivers in whom no impairing drugs or alcohol was detected. After responsibility analysis 437 of the control group were ‘responsible’ and 345 were not ‘responsible’. The odds ratio for the control group being responsible for the collision was defined as 1. Cases in which the driver 'contributed' to the collision (n=175) were excluded from final analysis.

Results
Injured drivers were 62.8% male with a mean age of 36.8 years (range 14-91, s.d. 16.2). There were 43 drivers (8 female) below the legal driving age of 18 years.

In the control group age was a factor for responsibility at all ages with the oldest and youngest drivers most likely to be responsible.14 of the underage drivers were drug and alcohol free with an odds ratio of responsibility for collision of 2.5.

Table 1: Age as a factor in responsibility in drug and alcohol free drivers

Age	**Responsibility Analysis**			**Odds Ratio**
	Responsible	**Contributory**	**Not responsible**	
15 to 17	9	2	3	2.4
18 to 14	136	52	73	1.5
25 to 34	75	27	63	0.9
35 to 44	68	31	62	0.8
45 to 54	53	19	87	0.5
55 to 64	42	25	39	0.9
65 to 74	26	8	8	2.6
75 to 84	20	9	6	2.6
85+	8	2	1	6.7
Total	**437**	**175**	**345**	

Twenty six (65%) of the underage drivers had a blood alcohol concentration (BAC) between 0.011% and 0.198% (mean of 0.091%). 38 were responsible for the collision (O.R. 10.6).

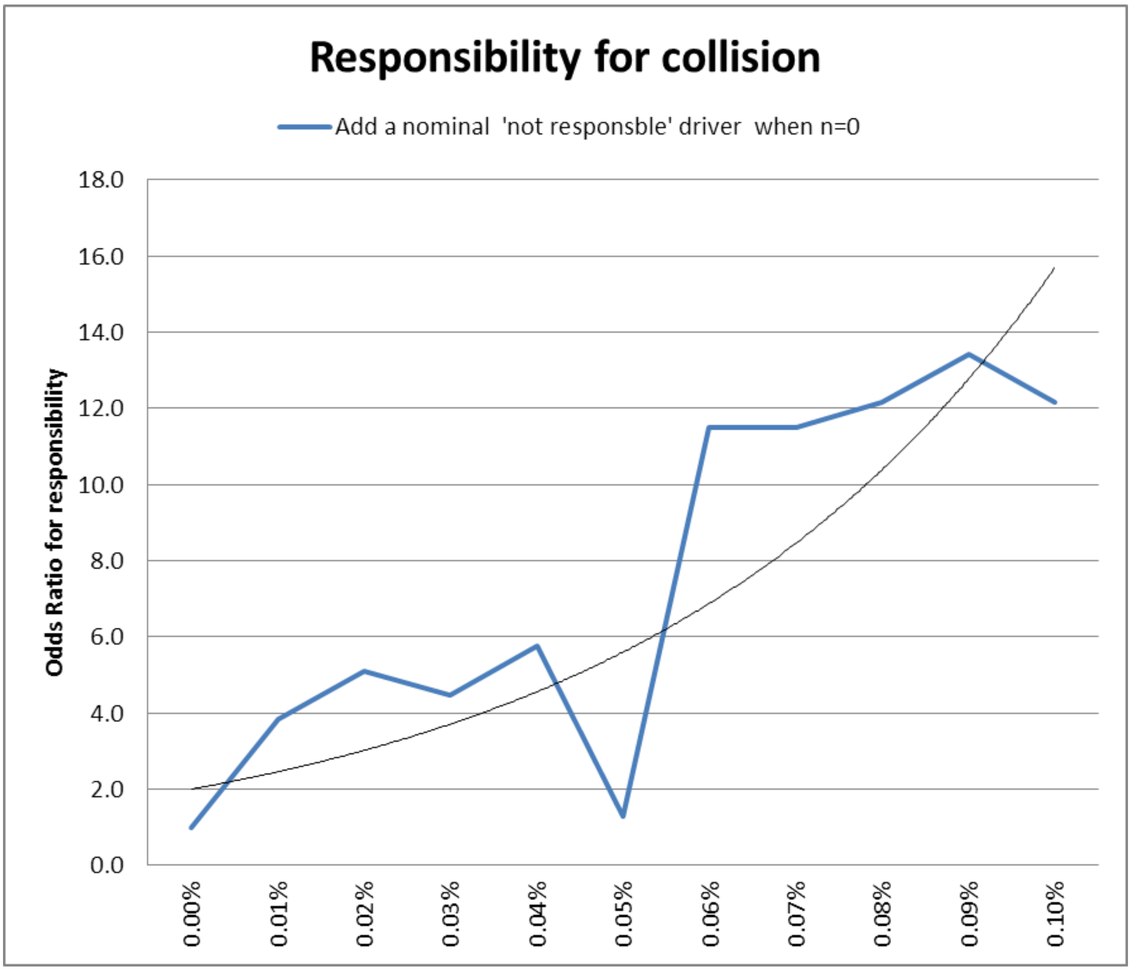
46 drivers had blood alcohol concentrations between 0.001% and 0.05%. Only 3 were not responsible for the collision, 8 contributed and 36 were responsible for the collision (Odds Ratio 7.7). 82% of these collisions involved another vehicle.

Blood alcohol concentration	**Responsibility analysis**			**Odd Ratio** (after adding 1 to not responsible group)
	Responsible	**Contributory**	**Not Responsible**	
0.00%	657	222	420	1
0.01%	6	0	0 (1)	3.8
0.02%	8	0	0 (1)	5.1
0.03%	7	2	0 (1)	4.5
0.04%	9	5	0 (1)	5.7
0.05%	6	2	3	1.4
0.06%	18	1	0 (1)	11.5
0.07%	18	0	0 (1)	11.5
0.08%	19	0	0 (1)	12.1
0.09%	21	1	0 (1)	13.4
0.10%	19	2	0 (1)	12.1

Age was not a factor in the collisions with low blood alcohol concentrations (P=0.004).

The low number of drivers 'not-responsible' means it is impossible to estimate the odds ratios in most categories. In order to illustrate the exponential trend line, a nominal driver was added to the 'not responsible' count for each category to perform the calculation.

The blood samples were all taken after arrival at hospital. Typically this means a delay of an hour between the time of the collision and drawing the blood sample. This means that the measured blood alcohol concentration could have been lower or higher at the time of collision. In the further research the time delay should be quantified.



It must be noted that the study is subject to a bias in sample selection by hospital practitioners. In 1990 when the focus of road safety interventions was on alcohol, emergency physicians argues that blood sampling was an unacceptable clinical obligation distracting from clinical care. Police agreed that doctors could perform preliminary breath tests (PBT) on patients to determine the need for a blood sample. If the patient returned a negative PBT they were not required to furnish a sample, unless there was a clinical reason to suspect drug use. This pragmatic compromise was contrary to the legislation but encouraged cooperation with sampling for alcohol.

Since that time there has been increasing interest in the role of other drugs and screening for delta-9-tetrahydrocannabinol, methylenedioxymethamphetamine and methamphetamine began in 2004 (Victoria 2003). In 2009 Victoria Police formally requested hospitals and members of the College of Emergency Medicine to stop using preliminary tests and fully comply with the legislation obtaining samples from all drivers regardless of blood alcohol concentration. Since the request was made, compliance has been rising steadily, resulting in a growing proportion of alcohol negative drivers available and a more reliable control sample.

Discussion and conclusions

The fact that a substance is found does not mean that it caused impairment. It is necessary to ask a series of questions: Does this substance cause impairment of human skills? If so, is such impairment universal or idiosyncratic? Does the impairment occur in normal dosages or only when the drug is used in excess? The presence of a drug may not necessarily mean the driver is impaired (Maki and Linnöila 1976). Some individuals will be impaired with levels of a drug normally considered therapeutic (e.g. sedatives), whilst dangerously toxic levels of other drugs may have no effect on driving skills (e.g. paracetamol) (Pearl, Holder et al. 1989). There is no critical level of most drugs above which impairment is present or below which no impairment can be demonstrated (Starmer, Vine et al. 1988; Starmer and Mascord 1994).

The work of Terhune in the United States (Terhune, Ippolito et al. 1992) and Drummer's group in Australia (Robertson and Drummer 1994; Drummer, Gerostamoulos et al. 2003; Drummer, Gerostamoulos et al. 2004) has examined the culpability of fatally injured drivers. More recently the methodology has been used in France with similar results (Gadegbeku, Amoros et al. 2010).

Longo et al. reported data on the effect of alcohol, cannabis, stimulants and benzodiazepines on driver culpability in 2500 non-fatally injured drivers (Longo, Hunter et al. 2000). They found a clear, concentration dependent relationship between alcohol and responsibility for collision. This is in keeping with the findings of Terhune using non-fatally injured drivers (Terhune 1982) and the findings in fatally injured drivers (Terhune, Ippolito et al. 1992).

Very low levels of alcohol affect performance, and even a very small effect may be relevant in road safety (Moskowitz and Robinson 1988). A meta-analysis of acute alcohol consumption concluded that after two standard drinks the odds of injury were almost double (Taylor, Irving et al. 2010). The National Health and Medical Research Council advises that "Very low levels of alcohol can affect judgement and performance, and even a very small effect may be relevant where a high degree of skill is needed, where the risk is already high, or where the safety of others is involved" (NHMRC 2001).

The data presented here show that the odds of responsibility for collision in which the driver is injured and taken to hospital are increased at any blood alcohol concentration greater than 0.01%. This study provides further evidence that low levels of alcohol are associated with increased responsibility for collision and provides further support for zero tolerance.

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Responsibility for non-fatal collision: the abuse of benzodiazepines.

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Abstract

Background
Benzodiazepines are widely prescribed because of their inherent short term safety. However prolonged use can be associated with physical dependence and they are subject to misuse as intoxicants. They are known to impair driving and increase collision risk.

Aims
This study is part of a larger project examining detection of drugs in the blood of injured drivers and the odds of being responsible for a collision in which the driver is injured.

Methods
Motorists taken to hospital after a motor vehicle collision in Victoria, Australia, are required to provide a sample of blood for analysis. This sample is routinely analysed for the presence of proscribed drugs and alcohol. The samples were also analysed for impairing substances including benzodiazepines. Collisions were subject to responsibility analysis and the odds of being responsible for collision compared with the drug and alcohol free cohort.

Results
1809 drivers injured in collisions occurring between September 2009 and October 2010 have been included in this study. 184 (10.2% had a benzodiazepine present, mostly diazepam and its metabolites). 20.1% had benzodiazepines in toxic range indicating abuse of medication.

Discussion and conclusions
The number of drivers with toxic levels of benzodiazepines reflects abuse of medication and all these drivers were responsible for the collision. Alprazolam is particularly popular as a drug of abuse. It accounts for 8.4% of benzodiazepine prescriptions but 23.9% of affected drivers, the majority of whom (93.4%) were responsible for the collision. 94% of drivers with any benzodiazepine and alcohol were responsible for the collision regardless of the BAC.

Benzodiazepines are associated with an increase in odds of being responsible for non-fatal collision. The relative risk is probably dose related which has implications for prescribers and

their patients. The combination of benzodiazepines with any amount of alcohol causes synergistic impairment to the extent that 98% of drivers were responsible for the collision in which they were injured. The misuse of benzodiazepines as intoxicants requires attention of legislators and enforcement agencies. Traditional interventions may not be effective as impairment is unlikely to be detected by police if the blood alcohol concentration is low.

Introduction

Benzodiazepines are widely prescribed for the treatment of anxiety, insomnia, seizures, drug withdrawal, muscle spasm and sedation for medical procedures. They are used because of their inherent short term safety. However they can cause physical dependence and are subject to misuse as intoxicants. The 2010 National Drug Strategy Household Survey reported that recent use of illicit drugs and pharmaceuticals for non-medical purposes had increased over the previous 3 years (AIHW 2010).

Motorists taken to hospital in Victoria after a motor vehicle collision are required to provide a sample of blood for analysis (Victoria 1986). This study aimed to test the hypothesis that benzodiazepines increase the relative responsibility for collision using responsibility analysis.

Methods

A person over the age of 15 years, who is taken to hospital following a motor vehicle collisions required to furnish a sample of blood for analysis (Victoria 1986). The sample is divided into three aliquots: a 'screening' sample, a 'patient' sample which is given to the patient and an 'evidential' sample which is stored for formal analysis and potential prosecution. The screening sample was used for this study.

The first 936 samples were screened by Victorian Forensic Sciences Centre (VFSC). Subsequent blood samples (n=1801) were screened at the Victorian Institute of Forensic Medicine (VIFM). Both services are accredited by the National Association of Testing Authorities (NATA) in the provision of Toxicology for Forensic Science (ISO/IEC 17025:2005)

935 toxicology results were excluded because the sample was not from a pedestrian or passenger, the driver had not been injured in the collision, the collision was deliberate (failed suicide), the driver died within 30 days due to injuries sustained in the collision, or there was insufficient information in the collision report to perform the responsibility analysis. Toxicology results were matched against collision details by Victoria Police personnel.

Analysis of responsibility for collision was carried out using the method developed Robertson and Drummer (Drummer 1994; Robertson and Drummer 1994). A value between 1 and 4 is assigned to eight factors which might explain the collision: road condition, vehicle condition, driving conditions, collision type, witness observations, compliance with road laws, task difficulty and level of driver fatigue. The higher the value given, the more the extenuating factors are likely to have contributed to the collision. A driver with a low aggregate low score (score <13) is judged to be 'responsible' for the collision, a driver with a mid-range score (≥13 and ≤15) is defined as 'contributing' to the collision, and a driver with a high score (15 and above) is defined as 'not responsible' for the collision. Responsibility analysis was carried out blinded to knowledge of the toxicology to avoid expectant bias.

The control sample was the group of drivers in whom no impairing drugs or alcohol was detected (n=957). The odds ratio for the control group being responsible for the collision was defined as 1. Cases in which the driver “contributed” to the collision (n=237) were excluded from final analysis.

Results

Injured drivers were 62.8% male with a mean age of 36.8 years (range 14-91, s.d. 16.2). There were 32 male and 8 female drivers below the legal driving age of 18 years. 20 learner drivers had drugs or alcohol detected.184 drivers (10.2%) had a benzodiazepine present, mostly diazepam and its metabolites.

Other studies of drug prevalence in Australia have shown a similar prevalence of benzodiazepines (Longo, Hunter et al. 2000; Drummer 2002; Ch'ng, Fitzgerald et al. 2007; Drummer, Kourtis et al. 2012) .

Table 1: Comparison of results from similar studies

	Longo	Ch’ng	Drummer	Current study	
Number in study	**2500**	**436**	**3398**	**1809**	**n**
Drug &Alcohol Neg.	77.4%		50.1%	50.3%	907
Alcohol Positive	12.4%		23.2%	28.2%	508
Stimulants alone	0.8%		1.6%	1.7%	31
Stimulants (total)		4.1%		5.7%	103
Benzodiazepines alone	1.8%		1%	1.8%	32
Benzodiazepines (total)		15.6%		10.2%	184
THC alone	7.1%		1.7%	2.4%	43
THC (total)		4.6%		10.0%	181

The most commonly prescribed benzodiazepines in Australia are (in rank order) temazepam, diazepam, oxazepam and nitrazepam. The benzodiazepines detected are shown in table 2. The total number of detections exceeds the number of subjects who tested benzodiazepine positive because many patients tested positive for several members of the class.

Diazepam is metabolised to nordiazepam, oxazepam and temazepam which means these four compounds are detected together after ingestion of diazepam.

Table 2 – benzodiazepines detected

Substance	**N**	**Mean mg/L**	**Std. Deviation**	**Range detected mg/L**	**Therapeutic range mg/L**
Diazepam	113	0.273	0.229	0.001 to 7.0	0.125 to 0.25
Nordiazepam	100	0.149	0.094	0.02 to 2.19	
Temazepam	69	0.026	0.039	0.01 to 1.3	0.02 to 0.15
Oxazepam	33	0.048	0.126	0.001 to 5.17	1 to 2
Nitrazepam	10	0.0017	0.009	0.02 to 0.09	0.013 to 0.2
Clonazepam	1	0.0022	0.002	0.04	0.03 to 0.06
Flunitrazepam	2	0.00024	0.003	0.004 to 0.04	0.005 to 0.015
Alprazolam	43	0.250	0.075	0.01 to 0.72	0.001 to 0.06
Zopiclone	1	0.400	0.00	0.4	0.01 to 0.05
Zolpidem	6	0.011	0.091	0.01 to 1.00	0.08 to 0.15
Total	**378**				

20.1% of the subjects had benzodiazepines present in toxic range indicating abuse of medication reflecting the popularity of these drugs as intoxicants or as adjuncts to abuse of other drugs.

The presence of benzodiazepines was associated with increased odds of being responsible for collision. The drivers with benzodiazepines in toxic range were all responsible for the collision in which they were injured.

Table 3 – odds ratio of responsibility for collision

Substance		Responsible	Not responsible	Odds Ratio
Diazepam	Low	33	4	6.9
	Therapeutic	40	2	16.8
	High	17	0	∞
	Toxic	7	0	∞
	All diazepam	**97**	**6**	**11.7**
Temazepam	Low	7	0	∞
	Therapeutic	51	5	8.5
	Toxic	1	0	∞
	All temazepam	**59**	**5**	**10.9**
Oxazepam	Low	22	2	9.2
	Therapeutic	6	1	5.0
	Toxic	1	0	∞
	All oxazepam	**29**	**3**	**10.5**
Nitrazepam	Low	5	1	4.2
	Therapeutic	3	0	∞
	All nitrazepam	**8**	**1**	**5.9**
Alprazolam	Low	5	0	∞
	Therapeutic	9	0	∞
	High	3	0	∞
	Toxic	23	0	∞
	All alprazolam	**40**	**0**	∞
Zolpidem	Low	1	1	0.8
	Therapeutic	1	0	∞
	Toxic	1	0	∞
	All zolpidem	**3**	**1**	**2.5**

Discussion

There is an increased risk of personal injury crashes among drivers using anti-anxiety drugs compared with the rest of the population (Skegg, Richards et al. 1979) and this is exacerbated by alcohol and other sedatives. A meta-analysis of over 500 studies showed that the serum level of each of the benzodiazepines studied was related to the degree of impairment in the laboratory (Berghaus 1997).

The benzodiazepine group has been shown to impair driving skills to a similar degree and in similar ways to alcohol. In general terms, the risk of collision is doubled for patients taking benzodiazepines. The impairment and collision risk are greatest in the first two weeks of treatment (de Gier, 't Hart et al. 1981). The ICADTS working group concluded that patients should be warned not to drive in the first two weeks of treatment (Alvarez and de Gier 2002). Although treatment with benzodiazepine tranquillisers will improve clinical anxiety, there is no improvement in driving ability (de Gier, 't Hart et al. 1981).

The benzodiazepines act to depress the central nervous system in qualitatively different ways. Some are better at relieving anxiety and are classified as tranquillisers. Others are more sedating and used to treat insomnia. Some members of the group are primarily used as anticonvulsants. There is no sharp distinction between any of these effects and higher doses of any of the benzodiazepines induce sedation and coma. There is a twentyfold variation in dose equivalence.

Different benzodiazepines have different abuse potential; the more rapid the absorption, the greater the intoxicating effect and the more open to abuse the drug becomes. The speed of onset of action of a particular benzodiazepine correlates well with the 'popularity' of that drug for abuse (Longo and Johnson 2000). The two most common reasons for preference for abuse are that a benzodiazepine is perceived as 'strong' and intoxicating. The number of drivers with toxic levels of benzodiazepines reflects abuse of medication.

Alprazolam is particularly popular as a drug of abuse. It accounts for 8.4% of benzodiazepine prescriptions but 23.9% of affected drivers, the majority of whom (40/43) were responsible for the collision. In fact, only one of those 44 drivers had a level of alprazolam in the low-therapeutic range and no other drug present. All 44 alprazolam-positive drivers either caused or contributed to their collision. There is discussion at a federal level of reclassification as a 'drug of addiction' in order to limit abuse.

The diazepam data shows a dose relationship between benzodiazepine level and collision risk. Larger numbers are needed to quantify this relationship effectively.

Diazepam level	**Odds Ratio**
Detectable	3.09
Low	6.45
Therapeutic	15.71
High/Toxic	45.00
Diazepam plus alcohol	41.00

98% of drivers with a benzodiazepine plus alcohol were responsible for the collision regardless of the blood alcohol concentration. This poses a substantial challenge for using enforcement as an intervention because drivers with low blood alcohol concentration plus benzodiazepines may be profoundly impaired but unlikely to be detected by police. There is a strong argument for zero tolerance for alcohol in drivers who are legitimately taking a benzodiazepine. The technology exists to add benzodiazepines to current random drug testing.

It must be noted that the study is subject to a bias in sample selection by hospital practitioners. In 1990 when the focus of road safety interventions was on alcohol, emergency physicians argues that blood sampling was an unacceptable clinical obligation distracting from clinical care. Police agreed that doctors could perform preliminary breath tests (PBT) on patients to determine the need for a blood sample. If the patient returned a negative PBT they were not required to furnish a sample, unless there was a clinical reason to suspect drug use. This pragmatic compromise was contrary to the legislation but encouraged cooperation with sampling for alcohol.

Since that time there has been increasing interest in the role of other drugs and screening for delta-9-tetrahydrocannabinol, methylenedioxymethamphetamine and methamphetamine began in 2004 (Victoria 2003). Victoria Police have formally requested hospitals and members of the College of Emergency Medicine to stop using preliminary tests and fully comply with the legislation obtaining samples from all drivers regardless of blood alcohol concentration. Compliance has been rising steadily, resulting in a growing proportion of alcohol negative drivers being tested for other drugs.

Conclusions

Benzodiazepines are associated with an increase in odds of being responsible for non-fatal collision. The relative risk is probably dose related but a larger data collection is required to elucidate the nature of the relationship. Drivers should be warned that there is a risk of collision similar to moderate doses of alcohol.

The combination of benzodiazepines causes synergistic impairment to the extent that 98% of drivers with any amount of alcohol present and a benzodiazepine at any level, were responsible for the collision in which they were injured.

The widespread misuse of benzodiazepines as intoxicants requires attention of legislators and enforcement agencies to detect and respond to the impairment. Traditional safety interventions may not be adequate to increase traffic safety. Prescribers must be made aware that these drugs are associated with significant increase responsibility for collisions so that they can discuss the associated risks with their patients who drive. The road safety community needs to consider remedial actions for abuse of prescription drugs.

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Cycling crashes: factors associated with head trauma, alcohol consumption and helmet use

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Abstract
Cycling is becoming one of the most common modes of transportation across the entire world, due to its simplicity, low cost, and health-related benefits. In a road crash, however, cyclists are among the most vulnerable road users and they can suffer more severe consequences compared to users of motorised vehicles. Alcohol consumption is a risk factor for being involved in a crash and for the consequences of a crash. Few studies have analysed the role of alcohol in bicycle crashes and the corresponding severity of outcome.
The aim of this study is to evaluate which cyclist and crash characteristics are associated with alcohol consumption among cyclists who have been involved in a crash.
The data source is the German In-Depth Accident Study database. All cyclists that were involved in a road crash between 2000-2010 and on whom an alcohol test was conducted were selected. A logistic regression analysis was carried out to evaluate the association between the rider's blood alcohol level (<0.05 mg/l vs ≥0.05 mg/l) and cyclist and accident characteristics. Female bicycle riders were less likely to have consumed alcohol compared to men (OR=0.23, CI=0.08-0.66); cyclists who did not wear a helmet were more likely to have consumed alcohol (OR=2.41, IC=1.08-5.38); cyclists who were not responsible for causing the road crash were less likely to have consumed alcohol compared to cyclists who were partially responsible (OR=0.22, CI: 0.08-0.61). Cyclists who were involved in a crash when road conditions were dry or slippery were more likely to have consumed alcohol (OR=2.44, IC=1.03-5.80).
Alcohol consumption is associated with unsafe cycling practices, for example not using a helmet or drive in bad road conditions, and with being the cause of a road crash. Preventing or limiting alcohol consumption and corresponding testing of cyclists must be improved.

Background
Cycling, being easy, inexpensive and healthy, is becoming one of the most popular means of transport the world over; bicycles are increasingly used for getting to work (Bacchieri et al., 2010). The cyclist population is therefore growing and becoming much more diverse.
Cyclists, however, are among the most vulnerable road users in traffic collisions. Indeed, cyclists, being less protected, less visible and more unstable, are likely suffer more severe consequences of road accidents than users of motorised vehicles.
The number of cyclist injuries and deaths, already high, increases year by year (NHTSA's National Center for Statistics, 2012; European Road Safety Observatory, 2011). Factors known to be associated with the risk of accidents and accident-related injuries are: age, rider experience, time and day of the week on which the accident occurred, and environmental conditions; helmet use and alcohol and drug consumption are also important factors (Ministry of Transport - New Zeland, 2012; Crocker et al., 2012; Bacchieri et al., 2010; Berg et al., 2007; Andersson and Bunketorp, 2002).
Road accidents have widely varying consequences, ranging from minor abrasions to fractures and death (Scheiman et al., 2010; Schwellnus and Derman, 2005). Different parts of the body can be involved (Abbas et al., 2011; Stranges et al., 2009; Abu-Zidan F.M. et al., 2007),

but the most serious injuries are those that involve the head and the spinal cord. These injuries have been found to be more frequent among cyclists who had abused alcohol and drugs and who were not wearing a protective helmet at the time of the accident (Li at al., 2001; Crocker et al., 2012; Airaksinen et al., 2010, Javouhey et al., 2006; Andersson and Bunkertorp, 2002; Li et al., 2000; Li et al., 1996).

Aims
The aim of this study, which analyses cyclists involved in collisions, is to establish which cyclist and accident characteristics are associated with alcohol consumption in this population.

Methods
The source used for the present analysis is the database of the German In-Depth Accident Study (GIDAS), which is the largest study of this kind in Germany. Whenever an accident occurs, the police, rescue services, and fire department headquarters in the areas of Hannover and Dresden immediately inform the research team that goes directly to the accident site and collect information on environmental conditions, road design, traffic control, accident details, vehicle damage and deformation, impact contact points, technical vehicle data, and information about the people involved. In addition to this information collected "at the scene", the researchers subsequently collect more detailed measurements of the vehicle (usually following day) and further medical information about injuries sustained and treatments administered. The accident is then reconstructed in depth. Each year approximately 2,000 traffic accidents are documented in this way (GIDAS, 2012).
All cyclists from the GIDAS database who were involved in a road accident between 2000 and 2010 and submitted to an alcohol test were selected for the present study. According to the limit set by German law, alcohol tests were classed as positive if the blood alcohol concentration (BAC) was equal to or greater than 0.05 mg/l.
In the years 2000-2010, a total of 4,928 cyclists were involved in road accidents. Of these, 299 underwent an alcohol test following the collision. Alcohol test results were available for 242 cyclists, who were thus included in the present analysis; the 57 cyclists whose alcohol test results were not known were excluded from the analysis.
Absolute and relative frequencies were used to describe the studied variables. To evaluate the severity of head trauma the Abbreviated Injury Scale (AIS) was used (Association for the Advancement of Automotive Medicine, 1990). Overall body injury severity was classified on the basis of the most severe injury sustained in each part of the body considered (MAIS). Cyclists with BACs over and those with BACs under the prescribed limit were compared. Comparisons were performed using a χ^2 test, or Fisher test when appropriate. A logistic regression analysis was carried out to evaluate the association between each cyclist's BAC (dependent variable) and the following variables: helmet use, age, gender, responsibility, use of cycle path, type of accident, road conditions, area, speed limit, weather conditions, day of the week, and collision consequences (independent variables). Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated.
Analyses were performed using the STATA software, version 10.

Results
In all, 242 cyclists involved in road accidents and submitted to alcohol testing were analysed. Of these, 104 (43.0%) were over the prescribed BAC limit and 206 (85.1%) were not wearing a helmet at the time of the accident. Fifty-one (21.4%) were aged 11-24 years, 162 (68.1%) 25-64 years, and 25 (10.5%) 65+ years; most (213, 88.4%) were male. In 133 (55.9%) cases, the cyclist was entirely responsible for the accident, and in 65 (16.8%) the other road user

was entirely responsible; in 34 (27.3%) cases they were both partially responsible. It emerged that 164 cyclists (69.8%) were not using a cycle path at the time of the accident. In 59 (24.4%) cases, the accident involved only the cyclist, whereas in 137 (56.6%) cases the cyclist collided with a motorised vehicle and in 46 (19.0%) with a non-motorised vehicle. Most of the accidents occurred on a dry road (204, 84.3%), in an urban area (195, 80.9%), with a speed limit ≥ 50 km/h (193, 81.1%), in good weather conditions (220, 90.9%), and on a weekday (181, 74.8%). Slight injuries (MAIS=1-2) were sustained by 194 (84.7%) of the cyclists, while severe injuries (MAIS≥3) were recorded in 14 cases (6.1%). Head injuries were sustained by 129 (56.6%) (Table 1).

The analysis of possible associations with alcohol consumption showed higher percentages of intoxicated cyclists among those who had not been wearing a helmet (59.7% vs 41.7%, p=0.044) and among the males (60.6 % vs 28.7%, p=0.001). As regards responsibility for the collision, the intoxication rate was highest (71.4%) among those who were at fault, 52.3% among those who were partially responsible, and 20.0% among those involved in a collision caused entirely by the other party involved (p<0.0001). The percentage of intoxicated cyclists was 47.4% among those who collided with a motorised vehicle, 60.9% among those involved in an accident with a non-motorised vehicle, and 76.3% among those involved in single-vehicle accidents (i.e. which involved no other party) (p=0.001). The percentage of intoxicated riders was higher in the group of cyclists who sustained head injuries compared with those who did not (62.8% vs 47.5%, p=0.021 (Table 1).

In the multivariate analysis (Table 2), the variables helmet use, gender, and responsibility remained statistically significant: the odds of being intoxicated were 2.41 (CI: 1.08-5.38) times higher among cyclists who did not wear a helmet than among those who did; 0.23 (CI: 0.08-0.66) times lower among females than males; and 0.22 (CI: 0.08-0.61) times lower among cyclists who were not at fault in the collision compared with those who were partially at fault. Road conditions were correlated with alcohol consumption in the mutually adjusted analysis: cyclists who were involved in a crash when road conditions were dry or slippery were more likely to have consumed alcohol (OR=2.44, IC=1.03-5.80).

Discussion and conclusions

Of 242 cyclists involved in collisions, 43% had a BAC≥0.05 mg/l. An association emerged between failure to wear a helmet at the time of the accident and a positive alcohol test. Cyclists travelling under the effect of alcohol are more likely to be at fault in an accident and they are more likely to be involved in a collision when road surface is slippery or wet. Females are less likely than males to cycle under the effect of alcohol.

The present study reveals a clear association between alcohol consumption and cycle helmet use: cyclists with a BAC≥0.05 mg/l are less likely than other cyclists to wear a safety helmet. This finding confirms the evidence emerging in previous studies, which showed that alcohol consumption in cyclists is associated with other unsafe riding behaviors, in particular, failure to use a helmet or ride in bad road conditions (Li et al. 2001, Airaksinen et al. 2010, Andersson and Bunketrop 2002, Crocker et al. 2010). The dismal rate of helmet use among “BAC-positive” cyclists is linked to alcohol-induced impairment of cognitive functions and safety behaviours. In addition, it is possible that people who ride bicycles after consuming alcohol are less likely than other cyclists to own a safety helmet, or to opt to wear a helmet when one is available. Moreover, some bicycle riders underestimate the seriousness of cycling after drinking alcohol, and these individuals probably also underestimate both the degree to which their ability to operate a bicycle is impaired after drinking and the ensuing risks. Injury prevention should be directed at changing attitudes towards cycling while under the influence of alcohol and at promoting the use of bicycle helmets.

In agreement with the findings of Martínez-Ruiz et al. (2013), the results of the present study show that cyclists with a blood alcohol level higher than the legally prescribed limit are more likely to be responsible for accidents. This is probably due to an alcohol-induced loss of attention, lucidity and stability, which makes the cyclist a danger to himself and to other road users.

In this study the males were found to be more likely than the females to ride a bicycle under the influence of alcohol, confirming previous findings in the literature (Airaksinen et al. 2010, Li et al 1996), revealed an association between gender and alcohol consumption in cyclists who are involved in collisions. The explanation for this finding may be related to differences in the behaviour of male and female cyclists. It is possible that male cyclists are more inclined to take risks and mind less about the social disapproval attached to certain behaviours such as drinking and driving.

The present study showed a higher rate of head injuries among the cyclists with a positive alcohol test, even though this association was not significant on the multivariate analysis. Higher rates of head injuries among cyclists riding under the influence of alcohol were also reported in previous studies (Andersson and Bunketorp, 2002, Crocker et al., 2010, Crocker et al., 2012) . A main reason for the association between alcohol consumption and injury is the deleterious impact of alcohol on psychomotor skills, cognitive functions, and safety behaviours. As a result, cyclists under the influence of alcohol find it difficult to keep their balance, negotiate traffic, and perceive and respond to hazardous situations. The fact that the intoxicated cyclists sustained injuries to the head and face to a much greater extent than the sober cyclists may be due to impairment of their ability to react, and thus to take action to protect themselves when they fell.

This study presents three main limitations, all concerning missing data. One is the low number of subjects submitted to the alcohol test; exclusion of those not tested drastically reduced the initial sample size: from 4928 to 299. The low rate of alcohol testing is due to the fact that the police do not routinely test cyclists involved in traffic accidents, only those suspected of having consumed alcohol or drugs (i.e. those seeming mentally confused or unsteady or having alcohol-smelling breath, watery or bloodshot eyes, slow or slurred speech, etc.). Moreover, in 57 of the 299 tested cyclists, the results of the alcohol test were not available: in these cases, no medical report was produced due to problems with the blood sample. The characteristics of the cyclists whose alcohol test results were lacking were, however, similar to those for whom we did have test results. The only variable that differed significantly between the two groups was age (p=0.037) (data not shown). Finally, a high percentage of missing data for some of the collected variables prevented us from analysing several interesting possible risk factors identified in the literature. However, there is no reason to believe these potential biases had any systematic impact on the results of this methodologically rigorous study.

In conclusion, showing that alcohol consumption in cyclists is associated with other unsafe riding behaviors, in particular, failure to use a helmet or drive in bad road conditions, and with being the cause of a road crash could be useful for the future development of injury prevention strategies. Particular attention should be paid to men riders. Preventing or limiting alcohol consumption and corresponding testing of cyclists must be improved.

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Table 1. Sample description (n=242)

Variables	n	BAC ≥0.05 (%)	p
BAC	**104**	43.0	
Age (years)			0.347
11-24	**51**	49.0	0.276
25-64	**162**	59.9	0.295
65+	**25**	52.0	0.900
Gender			0.001
Male	**213**	60.6	
Female	**28**	28.6	
Road conditions			0.406
Dry	**204**	55.9	
Wet/slippery	**38**	63.2	
Area			0.053
Urban	**195**	53.8	
Extra-urban	**46**	69.6	
Speed limit (km/h)			0.861
<50	**45**	55.6	
≥50	**193**	57.0	
Weather conditions			0.485
Good	**220**	57.7	
Bad	**22**	50.0	
Day of week			0.336
Monday-Friday	**181**	55.2	
Saturday/Sunday	**61**	62.3	
Use of helmet			0.044
No	**206**	59.7	
Yes	**36**	41.7	
Responsibility			<0.001
Cyclist alone	**133**	71.4	<0.001
Other party alone	**40**	20.0	<0.001
Both	**65**	52.3	0.315
Use of cycle path			0.476
No	**164**	58.5	
Yes	**71**	53.5	
Collision partner			0.001
Single-vehicle	**59**	76.3	0.001
Motorised vehicle	**137**	47.4	0.001
Non-motorised vehic.	**46**	60.9	0.558
Maximum AIS			0.409
0	**21**	61.9	0.589
1-2	**194**	54.6	0.224
3-6	**14**	71.4	0.278*
Head trauma (AIS)			0.021
No (0)	**99**	47.5	
Yes (1-6)	**129**	62.8	

*Fisher's exact test

Table 2. Factors associated with alcohol use (n=234)

Variable		**OR**	**CI**		**p**
Use of helmet	No vs Yes	2.41	1.08	5.38	0.032
Age	25-64 vs 11-24	1.90	0.92	3.92	0.082
Age	65+ vs 11-24	0.83	0.30	2.31	0.720
Gender	Female vs Male	0.23	0.08	0.66	0.006
Fault	Cyclist vs Both	1.84	0.90	3.78	0.096
Fault	Other vs Both	0.22	0.08	0.61	0.004
Type of accident	Motorised vehicle vs single-vehicle	0.54	0.22	1.30	0.168
Type of accident	Non-motorised vehicle vs single-vehicle	0.57	0.21	1.52	0.257
Road conditions	Wet/slippery vs Dry	2.44	1.03	5.80	0.042

Predictors of alcohol impairment among crash involved drivers and riders in Western Australia

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Abstract
Impairment due to alcohol continues to be a significant cause of traffic crashes and associated injury. In Western Australia 2010, around one-third of drivers/riders in fatal crashes recorded a Blood Alcohol Concentration level of 0.05g/100ml or higher. Understanding the risk factors for driver/rider impairment remains critical to establishing relevant and effective countermeasures. The aims of the study were to investigate various factors associated with reported BAC levels for motor car drivers and motorcycle riders involved in a crash in Western Australia during the period 2005-2009, and, to make relevant recommendations for policy and practice in managing the risk of alcohol impairment. Police reported crashes in Western Australia for the period 2005-2009 were extracted from the Integrated Road Information System. Multinomial logistic regression was used to identify the road user factors significantly associated with a driver/rider recorded BAC of 0.001-0.049g/100ml; 0.05-0.10g/100ml and ≥0.101g/100ml compared with zero BAC (reference group). Valid data for the period was available for n=25,653 crash involved drivers/riders. Compared with drivers/riders with a BAC level of zero, the odds of recording a higher level BAC was significantly greater for those who were younger, male, unlicensed, and not wearing a seat-belt. Location of crash (remote area) was only significant at the highest level of BAC. The findings highlight the need for interventions that target ‘at risk drivers’ and address the relationship between drink driving and other on-road risk behaviours.

Background
Alcohol is a highly researched, well-known cause of impairment for drivers and riders of motorised vehicles. It adversely affects reaction time, vision and judgment (WHO, 2007), thus significantly increasing the risk of a crash and the likelihood of death or serious injury in the event of a crash (Peden et al., 2004) even at Blood Alcohol Concentration levels as low as 0.04g/dl (Moskowitz & Fiorentino, 2000). For this reason the Blood Alcohol Concentration level for drivers and riders is typically restricted to 0.05g/dl for full licence holders and 0.00g/dl for novices (WHO, 2009).

In Australia, alcohol is thought to account for 30% of fatal and 9% of serious injury crashes (ATC, 2011). These proportions were similarly noted in Western Australia in 2010 were around a third of fatal crashes and 10% of serious injury crashes were reported to be attributed to alcohol (Hill, Thompson, Yano & Smith, 2012). Epidemiological investigations of crashes involving alcohol have identified a number of significant driver related predictors and associated on-road behaviours. First and foremost, males are significantly more likely than females to be affected by alcohol at the time of a crash (see Palamara, Kaura & Fraser, 2013). In Western Australia for example, around 71% of all road users killed or hospitalised in an alcohol-related crash were male (Marchant et al., 2008). A likely contributing factor to this gender variation is the substantially higher level of alcohol consumption by males compared with females (Wilsnack, Wilsnack, Kristjanson & Vogeltanz-Holm, 2009). Second to gender, drivers involved in alcohol related crashes (greater than 0.00gm%) are more likely to be younger rather than older. In Western Australia, up to 50% of drivers aged 17-29 years involved in a fatal crash in 2010 evidenced a Blood Alcohol Concentration greater than zero (Hill et al, 2012). The relatively high consumption of alcohol among younger age person (AIHW, 2008) plus their greater impairment at even low levels of alcohol relative to older age persons (Moskowitz & Fiorentino, 2000) increases their risk of crashing when having consumed alcohol.

Other evidence shows that the burden of road crash related injury associated with drink driving is disproportionately high in rural areas of Australia (Havard, Shakeshaft, Conigrave, & Sanson-Fisher, 2011). In 2008, 54% of alcohol-related road fatalities occurred on country roads (Miller, Coomber, Zinkiewicz, & Toumbourou, 2010). In WA in 2006, 48% of alcohol-related road fatalities and hospitalisations occurred in highly accessible areas, 8% in moderately accessible areas and 15% in remote and very remote areas (Marchant et al., 2008). It is clear that remote and very remote areas were over-represented in alcohol-related crashes as the population of these areas is very low. In recent review of alcohol related crashes and location of occurrence, Palamara et al (2013) suggested that the relatively high alcohol consumption by individuals who live in rural and remote areas (Parliament of Victoria Road Safety Committee, 2005) plus the lack of alternative transport options in these locations most likely increases the incidence of drink driving in these areas by local residents.

Lastly, there is evidence to suggest that drink-driving does not occur in isolation of other on-road risk behaviours such as failing to wear a seat belt (WHO, 2007; Oxley et al, 2009). It is possible that alcohol affected drivers make poor choices in relation to belt use; it is also possible that the factors that predispose drivers to drink and drive also predispose them to not wear a seat belt – independent of the influence of alcohol.

Aims

The aims of the study were to investigate various factors associated with police reported BAC levels for drivers and riders involved in a crash in Western Australia during the period 2005-2009, and, to make relevant recommendations for policy and practice in managing the risk of alcohol impairment.

Methods

Data retrieval and management

Police records of all on-road motor vehicle crashes (both police attended/reported and road user reported) occurring during the period 2005-2009 in Western Australia were extracted by Main Roads Western Australia from their Integrated Road Information System (IRIS). The data was imported to SPSS (Version 21) for management and analysis. After an initial set of analyses the larger dataset of crashes was reduced to those involving drivers of passenger cars, buses and trucks and riders of motorcycles and mopeds aged 17+ years for whom a Blood Alcohol Concentration (BAC) level was recorded. This procedure resulted in the identification of BAC level information for n=31,908 crashing drivers/riders.

Data analysis

The outcome variable for this investigation was driver/rider BAC level. Individual BAC levels were aggregated into the following four groups for analysis: 0.00gm/100ml; 0.001-0.049g/100ml; 0.05-0.10g/100ml and ≥0.101g/100ml. Categorical predictor variables of interest were driver/rider sex (male, female); age (17-19, 20-24, 25-39, 40-49, 50-59 and 60+ years); licence type (valid licence, no valid licence); use of seat belt/helmet (use, non-use), and location of crash (metropolitan Perth, regional Western Australia, remote Western Australia) as a proxy for residential location. Univariate statistics were undertaken to describe the frequency distribution of the outcome and predictor variables and their association. Multivariate analysis of the relationship between predictor variables and driver/rider BAC levels was initially undertaken using Ordinal Logistic Regression because of the ordinal nature of the dependent variable. However, after reviewing the goodness of fit and test of parallelism statistics this technique was rejected because the data did not support the required assumption of regression coefficients being equal for all categories of the outcome variable (Norusis, 2008). Alternatively, Multinomial Regression was undertaken; a technique which estimates coefficients for each outcome category.

Results

Descriptive statistics

Table 1 presents the frequency distribution of relevant driver/rider crash variables. Around eight in ten crashing drivers/riders were reported by police to have a zero BAC level.

Table 1: Frequency distribution of crashing driver/rider variables; WA 2005-2009

Variable	n	%
Blood Alcohol Concentration Level (gm%)	**31,908**	**100**
▪ 0.00	25,794	80.8
▪ 0.001-0.049	1,017	3.2
▪ 0.05-0.10	1,751	5.5
▪ ≥ 0.101	3,346	10.5
Vehicle type	**31,908**	**100**
▪ Passenger vehicle	28,959	90.8
▪ Motorcycle/moped	1,403	4.4
▪ Bus/truck	1,546	4.8
Sex	**31,771**	**100**
▪ Male	21,444	67.5
▪ Female	10,327	32.5
Age (years)	**31,908**	**100**
▪ 17-19	5,245	16.4
▪ 20-24	6,022	18.9
▪ 25-39	9,996	31.3
▪ 40-49	4,517	14,2
▪ 50-59	3,085	9.7
▪ 60+	3,043	9.5
Licence type	**30,157**	**100**
▪ Valid	27,842	92.3
▪ No valid licence	2,315	7.7
Seat belt/helmet use	**26,748**	**100**
▪ Used	26,077	97.5
▪ Not used	671	2.5
Location of crash (proxy for residence)	**31,897**	**100**
▪ Metropolitan Perth	23,307	73.1
▪ Regional Western Australia	5,525	17.3
▪ Remote Western Australia	3,065	9.6

A further 3.2% of drivers/riders presented with a BAC level greater than zero but *below* 0.05gm%, the legal limit for full licence holders. The remaining 16.5% of crashing drivers/riders presented with an illegal BAC, with the majority exceeding 0.100gm%. Most vehicle controllers were drivers of passenger vehicles (90.8%), male (67.5%), aged 25-39 years, (31.3%), holding a valid licence (92.3%), reportedly used a seat belt or helmet at the time of the crash (97.5%) and crashed in the Perth metropolitan area – the proxy for metropolitan residential location (73.1%). At the univariate level driver/rider BAC level was found to be significantly associated with vehicle type (X^2=295.03 df=6; p ≤ 0.001), sex (X^2=627.67 df=3; p ≤ 0.001), age (X^2=1467.94 df=15; p ≤ .001), licence type (X^2=1611.71 df=3; p ≤ 0.001), seat belt/helmet use (X^2=457.91 df=3; p ≤ 0.001), and location of crash (X^2=69.62 df=6; p ≤ 0.001). Drivers of buses/trucks, female drivers/riders, older age drivers, licensed drivers, users of seat belts/helmets, and drivers crashing/residing in metropolitan Perth were all significantly more likely to record a low legal or zero BAC level.

Multivariate analysis

The findings of the multivariate analysis of the data using Multinomial Regression are presented in Table 2 (over page). The appropriateness of the use of this procedure was confirmed by the significant statistics for the Likelihood Ratio Tests for the final model and the effect of the six selected driver/rider crash variables on driver/rider BAC level category. A BAC level of 0.00gm% was selected as the reference level. This analysis was based on complete data for n=25,264 drivers/riders, representing 79% of drivers/riders with a reported BAC level.

In relation to driver sex, males were consistently twice as likely as female drivers/riders to record a higher level BAC. For driver/rider age, increased odds of returning a higher BAC level – at all levels - were consistently noted for those aged between 17 and 39 years of age, while increased odds of a BAC of 0.05-0.10gm% and ≥ 0.101 gm% were noted for drivers/riders aged between 40 and 59 years. Unlicensed drivers/riders also showed consistently greater odds than licensed drivers of returning a higher level BAC, with the odds progressively increasing for higher BAC levels, ranging from OR=2.72 for a BAC of 0.001-0.049gm% to OR=4.53 for ≥0.101 gm%. A similar pattern of increasing odds with increasing BAC level was noted for drivers/riders who failed to use a seat belt or helmet, ranging from OR=2.53 for a BAC of 0.001-0.049gm% to OR=4.16 for a BAC of ≥0.101. Compared with drivers of buses and trucks, drivers of passenger vehicles and riders of motorcycles/mopeds had consistently higher odds of returning a higher level BAC, with drivers evidencing higher odds than riders at each BAC level. Unlike the preceding variables, location of crash, the proxy for residential location, was not consistently associated with higher BAC levels. At the lowest positive level of BAC (0.001-0.49gm%), increased odds (OR=1.22) were noted only for drivers/riders crashing/residing in regional areas of Western Australia, while drivers/riders crashing/residing in remote (OR=1.32) and regional (OR=1.21) areas of Western Australia showed greater odds of returning a BAC ≥0.101gm%.

Table 2 Multinomial Logistic Regression of crashing driver/rider BAC level; WA 2005-2009*

Variable	**Blood Alcohol Concentration Level (gm%)**								
	0.001-0.049			*0.05-0.100*			*≥ 0.101*		
	OR	*95%CI*	*P value*	*OR*	*95%CI*	*P value*	*OR*	*95%CI*	*P value*
Sex									
▪ Female^	1.00	-	-	1.00	-	-	1.00	-	-
▪ Male	2.36	1.97-2.82	.000	2.67	2.28-3.05	.000	2.46	2.20-2.75	.000
Age (years)									
▪ 60+^	1.00	-	-	1.00	-	-	1.00	-	-
▪ 17-19	3.76	2.59-5.47	.000	8.62	5.63-13.25	.000	3.46	2.58-4.71	.000
▪ 20-24	4.42	3.05-6.41	.000	12.00	7.85-18.35	.000	7.80	5.81-10.49	.000
▪ 25-39	2.60	1.79-3.77	.000	6.44	4.21-9.85	.000	6.33	4.73-8.47	.000
▪ 40-49	1.51	0.98-2.31	ns	2.92	1.82-4.62	.000	3.94	2.89-5.38	.000
▪ 50-59	1.40	0.88-2.23	ns	2.42	1.46-3.98	.001	2.37	1.67-3.34	.000
Licence type									
▪ Valid^	1.00	-	-	1.00	-	-	1.00	-	-
▪ No valid licence	2.72	2.17-3.40	.000	3.14	2.64-3.73	.000	4.54	3.99-5.14	.000
Seat belt/helmet use									
▪ Used^	1.00	-	-	1.00	-	-	1.00	-	-
▪ Not used	2.53	1.72-3.71	.000	3.30	2.48-4.40	.000	4.16	3.35-5.16	.000
Vehicle type									
▪ Bus/truck^	1.00	-	-	1.00	-	-	1.00	-	-
▪ Passenger vehicle	8.62	3.55-20.94	.000	5.58	3.18-9.71	.000	12.97	7.41-22.60	.000
▪ Motorcycle/moped	7.74	3.04-19.67	.000	2.97	1.59-5.57	.001	7.56	4.18-13.68	.000
Location of crash (proxy for residence)									
▪ Metropolitan Perth^	1.00	-	-	1.00	-	-	1.00	-	-
▪ Remote Western Australia	0.90	0.69-1.18	ns	1.12	0.92-1.36	ns	1.32	1.14-1.53	.000
▪ Regional Western Australia	1.22	1.01-1.46	.030	1.14	0.98-1.32	ns	1.21	1.07-1.37	.001

*Reference category: BAC level 0.00gm%. ^ Reference value. -2 Log Likelihood=1.732E3 χ^2=2.876E3, df=36, p<0.001

Discussion and conclusions

This investigation has shown that around two in ten drivers/riders in Western Australia during the period 2005-2009 crashed with a BAC level greater than zero and that most (10.5%) presented with a BAC greater than 0.100gm% – double the legal limit in Western Australia. Second to this, the research noted that a number of driver/rider variables were independently associated with the likelihood of crashing with a BAC greater than zero.

The finding that males were twice as likely as females to record a higher BAC at all three levels is consistent with previous research that has identified males as being more likely to crash while impaired by alcohol and serves to again underscore the relatively greater disposition of male drivers/riders to engage in aberrant, risky behaviour on the road. Similarly, the increased odds of younger age drivers, particularly those aged 20-24 years, to drive and subsequently crash with illegal levels of BAC, highlights a contributing factor to well-known increased crash risk among this age group. It also highlights the need to address the high level of alcohol consumption among this group which contributes to the increased likelihood of drink-driving.

The association of unlicensed driving and non-use of seat belt/helmet with increasing driver/rider BAC level supports the contention that aberrant risky driving behaviours can be part of a syndrome of on-road risk behaviours and may share a common antecedent. As such, interventions should adopt a 'common solutions' approach rather than targeting problem driver behaviours in isolation of others.

The findings also highlight the relatively low level of positive BAC among presumably 'professional' drivers, that is drivers of buses and trucks for whom a zero BAC level would normally apply. Fewer than 3% of drivers of buses and trucks recorded a BAC greater than zero, while drivers of passenger vehicles and riders of motorcycles and mopeds were respectively 12 to seven times more likely than 'professional' drivers to record BAC levels in excess of 0.100gm%.

Finally, there was inconsistent evidence to conclude that drivers/riders crashing in non-metropolitan areas, and presumably residing in those areas, are significantly more likely to be affected by alcohol at the time of a crash. The noted exception to this was for the highest level of BAC: compared with metropolitan drivers/riders, remote and regional drivers/riders were 30% to 20% more likely to crash with a BAC ≥ 0.101gm%. This could be due to a number of factors in these areas, including more relaxed community attitudes towards drinking and driving, a lack of alternative transport options, and a low risk of enforcement and detection – real or perceived – for drink-drivers/riders in these areas.

The findings of this study have shown that the BAC of crashing drivers/riders is influenced by or associated with a number of factors. The results suggest that the high priority targets for drink-driving countermeasures include males and drivers/riders aged 17-39 years. Somewhat less so, closer consideration should be given to the factors that increase the likelihood that drivers/riders in regional and remote Western Australia will drive and crash with significantly high levels of BAC. Lastly, countermeasures should acknowledge the identified relationship among driver/rider risk behaviours such as drink-driving, unlicensed driving and non-use of seat belts/helmets and target the common causes to these co-related behaviours.

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Risk behavior, sensation seeking and impulsivity: study comparing drunk drivers with sober drivers

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Abstract

Background
Scientific evidences show that drivers who drink and drive tend to be more impulsive and high sensation seekers, as well as more susceptible to risky behaviors and traffic accidents.

Aims
To compare drivers who had DUI infractions in the previous year with drivers who did not in relation to their rates of impulsivity, sensation seeking (SS) and traffic risk behaviors.

Methods
The sample comprised 50 drivers with infractions (86% male) and 106 with no infraction (73.6% males) recruited in the Brazilian Traffic Department and three Driving Training Centers. Measures utilized were the Barrat Impulsivity Scale (BIS-11), the Sensation Seeking Inventory of Arnett (AISS) and the Driver Behavior Questionnaire (DBQ). We compared groups using chi-square with a 5% level of significance.

Results
The mean age for offenders was 39.2±12.6, compared to 42.29±12.9 of the non- offenders. Offenders showed higher means in the violation scores of the DBQ ($p<0.001$). Lifetime involvement with accidents were more prevalent among offenders ($p=0.001$). A statistical difference was verified among the groups also in the impulsiveness and sensation seeking scores ($p<0.001$ and $p=0.003$, respectively).

Discussion and conclusions
Data suggest that offenders for DUI differ from non-offenders in relation to personality traits - sensation seeking and impulsivity - and they would tend to commit other traffic violations. Although preliminary, our results may help discuss measures for assessment, rehabilitation and traffic enforcement.

Introduction

Human behavior in traffic has been an object of study since the first decades of the 20th century, driven by the increase in the use of vehicles in urban transportation and the growing involvement of drivers in automobile accidents (Tillman & Hobbs, 1949; Mckenna, 1983; Ulleberg & Rundmo, 2002). More recently, it was verified that more than 90% of the accidents are associated with human factors involving violations of traffic laws (Mohan & Tiwari, 1998; Nantulya & Musiime, 2001), such as drinking and driving.

For decades, studies warned against the combination of drinking and driving, mainly because of the resulting increase in the risk of severe injuries, accidents and mortality (Freeman, 1960, Beck, 1981, Das et al., 2012). Some studies have attempted to describe the personality traits of offending drivers. Scientific evidence shows that drivers who drink and drive tend to be more impulsive and high sensation seekers, as well as being more susceptible to risky behaviors and traffic accidents (Jonah, 1997, Ryb et al. 2006, Zakletskaia et al., 2009).

In Brazil, a country that has recorded about 43,000 deaths due to traffic accidents in 2010 (www.datasus.gov.br) there are few studies assessing the behavior of the driving population.

Based on what was described, the present study intends to compare drivers who had DUI infractions in the previous year with drivers who did not in relation to their rates of impulsivity, sensation seeking (SS) and traffic risk behaviors. It is hoped that this work contributes to the identification of potential risk factors associated with the committing of violations for an area of study where data is still considered internationally scarce.

Method

Sample

The sample selection was done by convenience and was comprised of 156 subjects distributed into two groups: a) 50 drivers who had DUI infractions in the last 12 months (cases) and b) 106 drivers without any history of traffic violations noted in the same period (controls). The drivers were selected from the Traffic Department of Rio Grande do Sul - DETRAN-RS and from three Driving Training Centers of the city of Porto Alegre in the south of Brazil.

All participants came from Porto Alegre city, had their license for two or more years and had a valid NDL at the time of the interview. Non-offenders who declared having no violations in the last 12 months at the time of the interview, but presented in their record, before DETRAN-RS, one or more violations committed in the last 12 months, were excluded.
The main studied factors included indicators for impulsiveness, sensation seeking and risky behavior. The endpoint considered in the study was had DUI infractions.

The data collection took into consideration the period of May to December 2012 and was performed by three trained interviewers. The estimated time for each interview was approximately 40 minutes. Interviews were conducted individually.

Data Collection Instruments

Socio demographic and traffic behavior data questionnaire: a standardized questionnaire to collect socio-demographic data such as gender, age, educational background and occupation.

Barrat Impulsiveness Scale version 11 (BIS-11): is one of the most used instruments in studies to measure the impulsiveness (Patton, Stanford & Barrat, 1995). The scale can be self-administered comprised of 30 items. In addition to a global score, BIS-11 allows the calculation of sub-scores regarding three sub-domains of impulsiveness which are motor, attentive and non-planning impulsiveness.

Arnett Inventory of Sensation Seeking (AISS): consists of a self-administered instrument comprised of 20 items, related to the manifestations of the sensation seeking trait and based on the theoretical model proposed by Arnett (1994).

Driver Behavior Questionnaire (DBQ): is one of the most widely used instruments to evaluate drivers behavior, having as theoretical reference the human error and its involved psychological processes (Reason et al., 1990). It is a self-administered questionnaire consisting of 50 items related to three factors: errors, lapses and violations.
Analysis Model

The instruments used in this study - BIS-11, AISS and DBQ - were analysed by mean scores.

Data Analysis
The data were entered and stored in the program Epidata (Version 3.1). Statistical analysis was performed using PASW *Statistic for Version* 18. The qualitative categorical variables were represented by the percentage of absolute and relative frequency. The chi-square test was used to verify the association of those variables with the analyzed groups (offenders and non-offenders). The quantitative variables were represented by the mean and standard deviation compared between the groups by the t Student test for independent samples.

Ethical Considerations
All participants have signed the Free and Informed Consent (FIC). This study was approved by the Research and Ethics Committee of Hospital de Clínicas de Porto Alegre, registered under number 11-0036 and by DETRAN-RS under Official Letter # GAB/17-11.

Results

Table 1 shows the sample characteristics and variable distribution between the two groups – offenders and non-offenders. The groups did not differ in relation to age, gender, education, ethnicity and occupational situation. However, a statistical difference was found between groups regarding the individual income (p=0.009).

Table 1. Sample characteristics and distribution of sample variables between the groups of – offenders and non-offenders.

Variables	Offenders	Non Offenders	p	Total
	n=50	n=106		N=156
Age¹	39.2 (12.6)	42.29 (12.9)	0.158	41.3 (12.8)
Gender (male)²	43 (86)	78 (73.6)	0.101	121 (77.6)
Years in School³	15.5 (11-16)	16 (11-16)	0.335	16 (11-16)
Race/Color²			0.999	
White	44 (88)	92 (86.8)		136 (87.2)
Non-white	6 (12)	14 (13.2)		20 (12.8)
Occupational Situation			0.39	
Works	46 (92)	86 (81.1)		132 (84.6)
Doesn't Work	4 (8)	20 (18.9)		24 (15.4)
Individual Income²#€	5,000 (2,575-10,000)	3,500 (1,800-5,800)	**0.009**	4,000 (2,000-6,000)

1 – representation by mean (DP). Made this T-Student test for independent samples. 2 – representation by absolute frequency (n) and relative(%). Made cui-square test. 3 – representation by median and CI (95%). Made Mann-Whitney test. €R$ (in Real). #Missing.

Table 2 shows the driving behaviors and personality measures in the total sample and among the groups – drunk drivers vs. sober drivers. The groups did not differ in relation to to the variables: driving time (in years) and type of car frequently used by the driver (car and van, p>0.995).

There was a statistically significant difference between the groups regarding risky driving behaviors - use cell phone while driving (p<0.001), use safety belt irregularly (p<0.001), be passenger of someone that drunk (p=0.036) and drove after using a psychoactive substance (p=0.037); offenders showed higher means in the violation scores of the DBQ (p<0.001). Still, it was found, among the offenders, a greater number of drivers that were involved in accidents with victims (in life). A statistical difference was verified between the groups also in the impulsiveness and sensation seeking scores (p<0.001 and p=0.003, respectively).

Table 2. Driving behaviors and personality measures in the total sample and among the groups – offenders vs. non-offenders.

Variables¹	Offenders	Non Offenders	p	Total
	n=50	n=106		N=156
Behavior and exposition in traffic				
Driving Time (in years)¹	19.1 (12)	20.1 (12.3)	0.645	19.8 (12.2)
Type of vehicle that drives the most²# (Car and Van)	46 (92)	98 (92.5)	0.995	144 (92.3)
Uses cell phone while driving (regularly)#2	40 (80)	28 (26.4)	<0.001	68 (43.6)
Uses safety belt irregularly#2	9 (18.4)	0	<0.001	9 (5.8)
Was passenger of someone that drunk£2	26 (52)	35 (33)	0.036	61 (39.1)
Drove after using a psychoactive substance £*2	4 (8)	1 (0.9)	0.037	5 (3.2)
Got involved in a traffic accident (TA)§2			0.001	
Did not get involved in a TA	15 (30)	57 (53.8)		72 (46.2)
Got involved in a TA without victim	23 (46)	40 (37.7)		63 (40.4)
Got involved in a TA with victim	12 (24)	9 (8.5)		21 (13.5)
Driving risk Behavior Measure				
DBQ - Driver Behavior Questionnaire				
Error¹	16.9 (2.5)	16.1 (2.7)	0.088	16.4 (2.7)
Lapse¹	18 (3.7)	17.3 (4.2)	0.353	17.5 (4)
Violation³	24.5 (20-28)	17 (15-21)	<0.001	19 (16-24)
Personality Measures				
BIS-11 (Global score)¹	59.7 (9.5)	52 (8.5)	<0.001	54.5 (9.5)
AISS (Global score)¹	48.4 (7.5)	44.4 (7.7)	0.003	45.7 (7.8)

1 – representation by mean (DP). Made this T Student test for independent samples 2 – representation by absolute frequency (n) and relative(%). Made chi-square test. 3 – representation by median and CI (95%). Made Mann-Whitney test. *Except alcoholic beverages.

Discussion

This study found that in the group of DUI offenders, a larger number of drivers were involved in risky behavior in traffic and serious accidents, when compared to the group of non-offenders; DUI offenders also presented higher scores on the DBQ factor violation. These findings corroborate previous studies, which identified that drunk drivers were more likely to commit violations - driving under the marijuana influence, to use seat belt irregularly, more often used a cell phone while driving while driving, speeding and present more fined violations (Beck, 1981, Wilson, 1992, Rauch et al. 2010).

Another important finding of the study refers to the fact that the group of offenders had higher impulsiveness scores compared with non-offenders. In 2005, Dahlen et al. (2005) found modestly higher scores on the BIS-11 among university offenders. Further, Ryb et al. (2006) found that high levels of impulsivity represent a risk factor for behavior in traffic, such as, not using the safety belt, drinking and driving, being a passenger of a driver who is drunk, speeding and getting involved in traffic accidents; probably due to the low perception of risk observed among more impulsive drivers. More recently, Moan, Norström and Storvoll (2013) verified that the drinking and driving behavior was significantly more prevalent among drivers who had higher impulsiveness scores.

Regarding trait sensation seeking, it was found that the group of DIU offenders had scores modestly higher on sensation seeking, corroborating previous studies (Jonah, 1997, Dahlen et al., 2005). In a study with 1,587 university students, Zakletskaia et al. (2009) found that the trait sensation seeking was the most robust predictor for drinking and driving ($OR = 1.52$, $CI = 1.19$ to 1.94, $p < 0.001$).

Conclusion

Our findings suggest that DUI offenders differ from non-offenders in relation to personality traits - sensation seeking and impulsivity - and they would tend to commit other traffic violations. Therefore they would represent a risky subgroup of drivers. Although preliminary, our results may help discuss measures for assessment, rehabilitation and traffic enforcement.

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Prevention of drink—driving in Viet Nam

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Abstract

Context

Road traffic injury is a leading cause of death and disability in Viet Nam, but information on the contributions of specific behavioural risk factors is limited. Research has highlighted that alcohol is a major contributor to road trauma in Viet Nam with surveys estimating more than 30% of road traffic fatalities and up to 60% of hospitalized road trauma patients with a blood alcohol concentration (BAC) above the legal limit (0.00-0.05g/dl).

Objectives

An ongoing collaboration between international partners and national and provincial government stakeholders is supporting the development and implementation of a comprehensive drink drive prevention program.

Key Outcomes

The adopted approach includes the following elements:

1. Review and revise legislation to close relevant enforcement loopholes and substantially increase penalties;
2. Training of large cohorts of national stakeholders (particularly police) in strategic enforcement principles and the development and implementation of social marketing campaigns;
3. Developing and implementing three mass media social marketing campaigns for national television;
4. Procurement of essential enforcement equipment (breathalysers) and training police in their use;
5. Intensive roadside enforcement operations ;
6. Monitoring and evaluation

Discussion and conclusions

With recognition of the role of alcohol in road trauma in Viet Nam, prevention of drink driving has been elevated to become a national road safety priority with support from the highest levels of Government.

The major challenge remains to see consistent and wide spread implementation of the new enforcement and public advocacy capacity developed through this program so that the lessons learnt from this small but successful pilot program can be scaled up nationally for the improved safety of all Vietnamese road users.

Context

Road traffic injuries are a leading cause of death and disability in Viet Nam. 2011 Statistics from the Ministry of Health reported 17,150 road traffic injury deaths, representing a mortality rate of 20.2 per 100 000 population[1].

Alcohol consumption is a well-established risk factor for road traffic crashes and the severity of injuries sustained in the crash, with research dating back several decades highlighting the exponential increase in crash risk associated from relatively low blood alcohol concentrations[23], particularly for motorcycle riders[4].

The most recently reported adult per capita (APC) alcohol consumption data for Viet Nam was 3.8L of pure ethanol per year, lower than the average for the countries of the Western Pacific Region of WHO (4.8L)[5], however certain provinces have substantial consumption with a sub-national survey estimating average daily consumption of more than 64g [6] which represents 29.9L APC per year.

The high alcohol consumption in Viet Nam is a strong predictor that it will also be associated with road trauma. Official reports suggest approximately 6% of injurious road traffic crashes are attributed to alcohol but this assessment is not based on empirical data and is thus recognized to be a likely underestimation of the true association[7]. In contrast, a study by the National Forensic Medicine Institute found that 34% of fatally injured drivers had a BAC greater than the legal limit[8] while a study from Hue Central Hospital found that 60% of all road traffic injured patients presenting in the Emergency Department, had a BAC exceeding the legal 80mg/dL limit at the time[9].

Striving towards consistency with international good practice, there has been a shift in Vietnamese Government policy towards prevention of drink–driving, resulting in a revision

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to the 2001 road safety law[10]. The 2008 revision of the law[11] reduced the BAC threshold from 0.08g/dL to 0.05g/dL blood for motorcyclists and from 0.08g/dL to zero for drivers of all other motorized vehicles. Taking effect in 1 July 2009, Viet Nam has one of the most stringent legislations in the region. With the revisions to the law, new penalties were also established including heavy fines, vehicle impoundment and loss of driving license[12][13].

Prioritization for the prevention of drink–driving in Viet Nam is increasing. In 2009 a national action plan was promulgated and commenced implementation[14]. Despite the increasing priority, there is still a low perception among road users of their chances of being caught and penalized by police. A WHO supported study on attitudes towards drink–driving in patrons of bars and restaurants in Da Nang in the central region of Viet Nam, reported that male drinkers generally perceive the possibility of being caught by police or suffering a punishment for drink–driving to be very low[15]. With such low public expectation of enforcement, it is essential that police demonstrate their presence and capacity to enforce anti- drink drive legislation with highly visible, enhanced enforcement operations in random locations and times.

Objectives

As part of the Bloomberg Philanthropies funded "Road Safety in Ten Countries" (RS10) program[16], the World Health Organization (WHO), the Global Road Safety Partnership (GRSP) and the International Injury Research Unit (IIRU) of John's Hopkins University have been working with the National Traffic Safety Committee (NTSC) and local counterparts in five provinces (Ha Nam, Ninh Binh, Quang Ninh, Bac Ninh, Vinh Phuc) to scale up road safety and specifically the prevention of drink—driving since 2010. The intervention model being implemented is an enhanced enforcement program where roadside operations of police are supported by legislation review and revision, intensive mass media social marketing campaigns, capacity building, essential equipment and monitoring and evaluation.

Further details of each component are outlined in the outcomes section

Key outcomes

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Legislation

Review of relevant legislation has identified various loopholes relating to the definitions and enforceability of drink—driving. Evidence based recommendations made by WHO and other partners have been noted in many instances and factored into legislation revision processes. Although some issues remain, the resulting national legislation for the prevention of drink—driving is both comprehensive and provides for heavy penalties for violators.

Capacity building

Through GRSP, a capacity needs assessment has been prepared and is being implemented with counterparts in all RS10 provinces. The primary target group are the provincial traffic police and the objective of all training programs is to strengthen capacity for the safe, strategic and efficient enforcement of drink—driving. Other components of the capacity building program have included principles and practices of developing social marketing campaigns as well as road safety systems for provincial based road transport companies

Social marketing and public advocacy

In conjunction with the NTSC, WHO has produced three social marketing campaigns between 2009 and 2012, all of which have been broadcast nationally on state and cable television. Associated with the preliminary stages of intervention in Viet Nam and the corresponding low public awareness of the risks as well as the illegality of drink—driving, campaigns to date have focused on the dangers and consequences of drink—driving as well as the scaling up of police enforcement.

Essential equipment

Since 2010, 120 fuel cell breathalysers as well as a large supply of consumables have been procured and distributed to national and provincial traffic police for use in road side enforcement operations as part of the program. Police have been fully trained in the use of the equipment and centralised training in the calibration and certification of equipment was also provided.

Roadside enforcement

Since 2010, WHO and now GRSP have supported national and provincial traffic police in the implementation of effective road side enforcement of drink—driving. Operational support includes the development of procedures and guidelines for safe and efficient operations. Between November 2010 and December 2012, enforcement operations in two provinces (Ha Nam and Ninh Binh) stopped and tested more than 9500 road users. 77.1% had no detectable alcohol, but 4.5% of motorcycle riders (0.25mg/L), 27.9% of car drivers (0.00mg/L) and 8.2% of bus and truck drivers (0.00mg/L) exceeded the legal limit for that particular class of vehicle.

Monitoring and evaluation

The International Injury Research Unit of John's Hopkins University School of Public Health is supporting the monitoring and evaluation of the intervention program. A wide variety of data are collected from multiple sources including hospital and police data on road traffic injuries and deaths and self-reported knowledge, attitude and practice (KAP) related to drink—driving via road side and household surveys.

Discussion and conclusions

With greater recognition, both publicly and governmentally, of the role of alcohol in road trauma in Viet Nam, prevention of drink driving is a major new priority for national road safety efforts.

Through the RS10 program (and its predecessor pilot in 2008-2009), WHO, GRSP and JHU have greatly contributed to this prioritization. The model programs and the lessons learnt in the five intervention provinces are being noted nation-wide which will hopefully result in a much wider scale up of similar implementation for the improved safety of all Vietnamese road users.

With implementation in this current phase continuing until the end of 2014, results are continually being generated and are reported at regular intervals through various mechanisms.

Acknowledgement

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An Examination of the Validity of the Standardized Field Sobriety Test (SFST) in Detecting Drug Impairment

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Abstract

Background and Aims

The purpose of this study was to assess the validity of the three components of the SFST — Horizontal Gaze Nystagmus (HGN), One Leg Stand (OLS), and Walk and Turn (WAT) — in identifying drug impairment.

Methods

Data from 2,142 completed Drug Evaluation and Classification cases involving central nervous system (CNS) stimulants, CNS depressants, narcotic analgesics (NA), cannabis or no drugs were analyzed using multinomial logistic regression.

Results

All four drug categories showed signs of impaired performance on the SFST. On the HGN test, users of CNS depressants were significantly more likely to experience lack of smooth pursuit and distinct nystagmus at maximum deviation compared to those who did not use drugs. On the OLS test, users of all four drug classes were significantly more likely to sway while balancing and use their arms to maintain balance, but were less likely to hop, as compared to drug-free cases. Users of CNS depressants, CNS stimulants and NA were also significantly more likely to put their raised foot down during the test. On the WAT test, users of CNS depressants, CNS stimulants and NA were less likely to keep their balance while listening to the test instructions compared to those who had not used drugs. Users of CNS depressants were less likely to touch heel-to-toe while walking, whereas individuals who had used NA were less likely to take the correct number of steps.

Discussion and Conclusions

These findings provide support for the use of the SFST as a screening tool for law enforcement to identify impairment in persons who have used CNS stimulants, CNS depressants, cannabis or NA. This work will have direct and immediate relevance to the training of police officers and will facilitate the enforcement of drug-impaired driving laws.

Background

The SFST has been widely implemented across Canada, the United States, and parts of Australia. Individual components of the battery have also been incorporated into the field impairment testing procedures used in many other countries, including the Drug Evaluation and Classification (DEC) program to detect impairment due to drugs (International Association of Chiefs of Police, 1999). Although the SFST is sensitive to alcohol impairment, few studies have assessed the test's ability to accurately detect drug-related impairment. The validity of using the SFST as part of the DEC program has to a large extent been inferred from studies of the overall accuracy of the DEC program to identify persons impaired by drugs other than alcohol. The problem with this approach is that the DEC program employs a much wider range of tests and measurements than the three tests of the SFST to identify drug impairment.

A group of researchers (Downey et al., 2012; Papafotiou et al., 2005a,b; Silber et al., 2005) in Australia have conducted a series of studies to determine the sensitivity of the SFST in detecting impairment due to substances other than alcohol. For instance, Silber et al. (2005) examined the effect of low doses of amphetamines on SFST performance at 120 and 170 minutes after ingesting the drug. None of the three amphetamines showed any evidence of impairment on the SFST.

Downey and colleagues (2012) explored the effects of MDMA and methamphetamine on SFST performance 4 and 25 hours following drug ingestion. Although methamphetamine was not found to impair performance on the SFST, the results showed that MDMA significantly impaired overall performance of the SFST in comparison to the placebo condition, with 22% of the participants being deemed impaired on two or more components of the SFST 4 hours post-drug consumption.

Papafotiou and colleagues (2005a,b) conducted two studies that assessed whether performance on the SFST provided a sensitive measure of impaired driving behaviour following the administration of either a low (1.74%) or high dose (2.93%) of THC. In the first study (Papafotiou, 2005a), participants performed a driving simulation task and the three components of the SFST. Results showed that driving performance was significantly impaired 80 minutes after the consumption of THC, while performance on the SFST correctly identified up to 76% of participants as being either impaired or not impaired. Papafotiou et al.'s (2005b) second study involved a more thorough examination of the three components of the SFST after administration of the same high or low dose of cannabis as used previously. The researchers also recorded head movement or jerks (HMJ) as a potential indicator of cannabis impairment. Findings revealed a positive relationship between the dose of THC administered and the number of participants classified as impaired. The inclusion of HMJ increased the number of subjects deemed to be impaired. Interestingly, lack of smooth pursuit (the first stage of HGN) was significantly related to cannabis use 55 and 105 minutes following administration of the drug, but not 5 minutes after cannabis smoking. This result is inconsistent with the DEC protocol as the only drug categories known to produce HGN are depressants, inhalants and dissociative anaesthetics. The authors noted that blood samples in their study were only tested for THC and as such, it is possible that the lack of smooth pursuit displayed by the participants may have occurred as the result of their consumption of drugs other than cannabis. Papafotiou and colleagues (2005b) also reported that subjects' performance on the WAT test was significantly related to THC condition, with two signs of this test being observed at all times: no balance and using arms to balance. Three signs of the WAT test were found to be unrelated to the level of THC during all administrations of this test, including misses heel to toe, improper turn, and incorrect number of steps. The authors also suggested that the OLS test provided the best indicator of impairment associated with the administration of THC.

Finally, Bosker and colleauges (2012) assessed the effects of smoking cannabis with and without alcohol on SFST performance in a study of heavy cannabis users. The results from this investigation showed that cannabis use (dose of 400 µg/kg body weight THC) was significantly related to impairment on the OLS test, whereas impairment on the HGN test only approached statistical significance. When cannabis was combined with alcohol (BACs of 50 and 70 mg/dL), participants' performance on the HGN was significantly impaired. Performance on the WAT test was not found to be impaired by cannabis either alone or in combination with alcohol.

Aims

The objective of this study was to examine data from the components of the SFST that are recorded during DEC evaluations to assess the validity of the three components of the SFST — Horizontal Gaze Nystagmus (HGN), One Leg Stand (OLS), and Walk and Turn (WAT) — in identifying impairment among suspected drug-impaired drivers.

Methods

Data from 2,142 DEC evaluations conducted across Canada involving a single drug category that were conducted during 1995-2009 were used in this study. Four classes of drugs were represented in this set of evaluations, including CNS stimulants (n = 852), CNS depressants (n = 135), NA (n = 312), and cannabis (n = 703). There were also 140 "no-drug" cases whereby the opinion of the evaluator was that the suspect was not under the influence of any drug and no drug was found as a result of toxicological analysis of the bodily fluid sample provided. Both of these criteria had to be met in order to be classified as a no-drug case.

Standardized Field Sobriety Test

Data from the DEC evaluations on the three tests that comprise the SFST battery were analyzed for their potential association with the four drug categories. These three tests are briefly summarized below.

Horizontal Gaze Nystagmus Test

HGN is an involuntary jerking of the eye that occurs naturally as the eyes gaze to the side. HGN is exacerbated by certain classes of drugs. During the HGN test, the eyes of an individual are observed as the individual follows a slowly moving object, such as a pen, horizontally with his or her eyes as it is moved from side to side. The officer separately observes the left and right eye for three signs: lack of smooth pursuit (present, absent); distinct nystagmus at maximum deviation (present, absent); and nystagmus onset before 45° (present, absent).

One Leg Stand Test

In this test, the individual is instructed to stand with one foot approximately 15 cm off the ground and count aloud from 1,000 (1,000, 1,001, 1,002, etc.) for 30 seconds. There are four signs from the OLS test that are scored: swaying while balancing on one leg; using arms to maintain balance; hopping during test; and putting the raised foot down.

Walk and Turn Test

In the WAT test, the participant is directed to take nine steps, heel-to-toe, along a straight line. After taking the nine steps, the participant must turn on one foot and return in the same manner in the opposite direction. There are eight signs of impairment that can be observed during this test: could not keep balance while listening to the test instructions; started the test before the instructions were completed; stopped walking during the test; did not touch heel-to-toe while walking; stepped off the line; used arms to maintain balance; took the incorrect number of steps; and turned improperly (i.e., not as demonstrated).

Data analysis
A series of multinomial logistic regression analyses were performed to assess the prediction of drug category from the various signs observed during the SFST battery. Separate analyses were conducted for each of the three components of the SFST. Classification rates for the outcome categories were also calculated as part of the analyses as they provide an estimate of the success of the model in correctly predicting the outcome category for cases for which the outcome is known.

Results
Prediction of Drug Category from Performance on Horizontal Gaze Nystagmus Test
A multinomial logistic regression analysis was performed to assess the prediction of drug category from performance on the HGN test. Results indicated that the set of three signs from the HGN test significantly distinguished the four drug categories of CNS stimulants, CNS depressants, NA and cannabis from the no-drug cases, χ^2 (12, N = 2,142) = 442.65, $p < .0001$. The classification rate for these drug categories was 42.2%; that is, less than half of all cases were correctly classified based on the inclusion of these three signs from the HGN test. The classification rate was 94.6% for CNS stimulants, 70.1% for CNS depressants, 0% for NA, and 1% for cannabis. As a follow-up to the overall multinomial logistic regression analysis, a series of binary logistic regression analyses were conducted to determine the specific signs from the HGN test that distinguished each of the four drug categories from the no-drug cases. Results indicated that users of CNS depressants were significantly more likely to experience lack of smooth pursuit and distinct nystagmus at maximum deviation compared to individuals who were not positive for drug use.

Prediction of Drug Category from Performance on One Leg Stand Test
A multinomial logistic regression analysis predicting drug category from performance on the OLS test showed that all four signs from this psychophysical test significantly distinguished the four DEC drug categories from the no-drug cases, χ^2 (16, N = 2,142) = 305.79, $p < .0001$. Based on this set of four signs, 43.6% of all cases were correctly classified, with classification being the highest for CNS stimulants (59.9%), followed by cannabis (55.4%), and NA (10.6%). No CNS depressant cases were correctly classified based on these signs from the OLS test. In examining the specific signs from the OLS test that distinguished the four drug categories from the no-drug cases, the results from the binary logistic regression analyses revealed that users of all four drug categories were significantly more likely to sway while balancing on one leg or use their arms to maintain balance during the OLS test, compared to individuals who had not used drugs. Users of CNS depressants, CNS stimulants and NA were also significantly more likely to put their raised foot down during the test. In contrast, the drug users across all four drug categories were less likely to hop during the OLS Test to maintain their balance compared to those who had not used drugs.

Prediction of Drug Category from Performance on the Walk and Turn Test
In predicting drug category from performance on the WAT test, the results revealed that the set of seven signs from this test significantly distinguished the four drug categories from the no-drug

cases, χ^2 (28, N = 2142) = 273.89, p < .0001. An overall classification rate of 42.8% was calculated based on these seven signs. Classification was found to be highest for CNS stimulants (72.2%), followed by cannabis (39.7%), CNS depressants (9%) and NA (3.5%). In assessing the specific signs from the WAT test that distinguished the four drug categories from the no-drug cases, findings revealed that users of CNS depressants, CNS stimulants and NA were significantly less likely to keep their balance while listening to the test instructions compared to individuals who were not impaired by drugs. In addition, users of CNS depressants were less likely to touch heel-to-toe while walking, whereas individuals who had used NA were less likely to take the correct number of steps during the WAT test.

Discussion and conclusions

The present study has demonstrated that CNS depressants, CNS stimulants, NA and cannabis are significantly associated with impairment on the SFST, with prediction being highest for CNS stimulants. The pattern of signs on the various tests of the SFST varied by drug category, which provides support for the validity of using the SFST to identify persons who are impaired by drugs other than alcohol.

Consistent with Bosker et al., (2012), the current investigation found that cannabis adversely affected performance on the OLS test, but not the WAT and HGN tests. These results, however, contrast with those reported by Papafotiou et al. (2005b), who noted that cannabis was related to impairment on all three tests of the SFST battery. As noted in the DEC program, cannabis is not one of the drugs that produce HGN (Drummer, 2007). It is possible that the HGN displayed by participants in Papafotiou et al.'s (2005b) study may have occurred because they consumed drugs other than cannabis. In their report, Papafotiou and colleagues noted that the subject's blood samples were only tested for THC. Papafotiou et al. also documented that cannabis was significantly related to impaired performance on the WAT test, a finding not evident in the current study. In reconciling these differing results, it is possible that they may be the result of differences in cannabis use history. In the study by Papafotiou et al. (2005b), the reported frequency of cannabis use of the participants varied from once a week to once every 2-6 months. In contrast, the present study was based on DEC evaluations conducted on suspected drug-impaired drivers who had self-administered drugs in doses that would be expected to exceed those that are ethically allowed in laboratory settings. Previous research has shown that heavy cannabis users develop tolerance to the impairing effects of THC on neurocognitive measures (Ramaekers et al., 2011). It is conceivable that the cannabis users in the current study developed tolerance to the impairing effects of THC as well, which may have affected their performance on the WAT test. Although cannabis users in the current work did not exhibit performance deficits on the WAT test, they did present such deficits on the OLS test. In accounting for these seemingly contradictory results, it is possible that the OLS may be too sensitive for determining drug use and that many individuals may not have very good balance even when they are not under the influence of drugs. This highlights the need for normative data to evaluate the performance of individuals on the SFST battery who are not impaired by drugs.

Contrary to previous research (Downey et al., 2012; Silber et al., 2005), the present study found that CNS stimulants were significantly associated with impaired performance on the WAT and OLS. The apparent discrepancy in these results is most likely a consequence of different doses of drugs across studies. Both Silber and colleagues (2005) and Downey and colleagues (2012) administered low doses of amphetamines under controlled conditions in a laboratory setting, whereas the current investigation was based on the results of DEC evaluations on suspected drug-impaired drivers who had self-administered drugs. The amount of drugs administered in the real world by drug users typically exceeds that ethically allowed in laboratory settings. Thus, higher doses of CNS stimulants were likely responsible for the differences in results between studies.

The findings observed in the current study provide support for the use of the SFST as a screening tool for law enforcement to identify impairment in persons who have used CNS stimulants, CNS depressants, cannabis or NA. It should be noted though, that the pattern of impairment is not necessarily the same as that displayed by persons who are impaired by alcohol. Foremost among the differences is the fact that CNS stimulants, cannabis, and NA do not produce HGN. The types of errors made on the various components of the SFST also appeared to differ by drug category. If replicated and validated by further research using larger samples with known drug-blood concentrations, these patterns of SFST signs would prove beneficial in identifying drug impairment and the identification of particular drug categories.

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Drivers in Alcohol Related Crashes in Saskatchewan

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Abstract

Background: Media reports of fatal crashes involving alcohol often leave the public with the impression that most impaired drivers "walk away" following a crash that has killed one or more innocent victims. While such stories are tragic, they are not necessarily representative of all alcohol-related fatal crashes. Impaired drivers are most likely to be the victim. These two very different crash scenarios may differ in terms of the characteristics of the impaired drivers involved and the circumstances of the crash itself.

Aim: The purpose of this study was to test the hypothesis that impaired drivers who survive fatal crashes do not differ from impaired drivers who die in fatal crashes in terms of circumstances of the crash or the characteristics of the drivers.

Method: Drivers involved in fatal crashes in the province of Saskatchewan from 1996 through 2009 were divided into groups according to alcohol status (no alcohol, had been drinking, BAC over 80 mg/dL) and crash survival. Data on the circumstances of the crash (e.g., day, time, location, number of vehicles involved) and the characteristics of the drivers (e.g., age, sex, prior driving record) were obtained from police collision files as well as the Saskatchewan Government Insurance records..

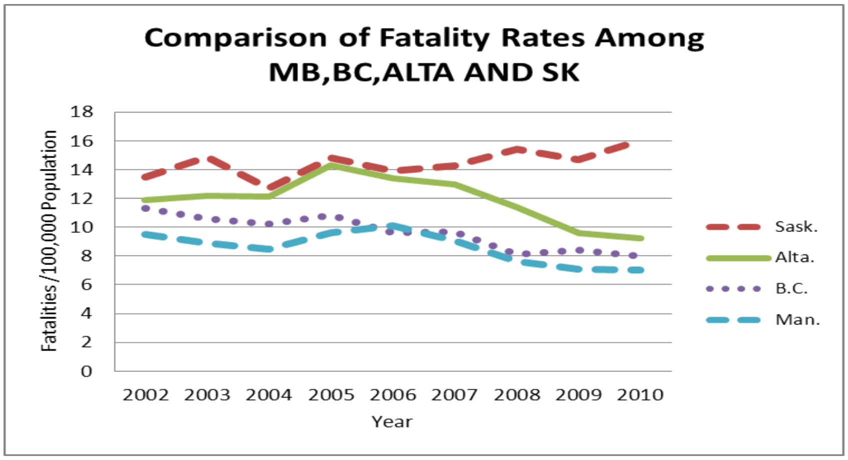
Results: In the case of high BAC drivers, the driver was the most likely to die followed by a vehicle occupant. Driver records were also assessed by high and low BACs. In the case of surviving drivers their prospective record was also assessed.

Conclusions: The findings serve to highlight the risks impaired drivers pose to themselves as well as other road users. The observed differences in impaired drivers who die in crashes and those who survive a fatal crash are of value in the development of public awareness and prevention programs as well as enforcement efforts.

Background

Saskatchewan is a province in Western Canada with a population of just over one million people. Following a significant reduction in the 1980s and 1990s, traffic fatality rates in Saskatchewan have been fairly stagnant over the past two decades with a slight upward trend in recent years. Saskatchewan's overall fatality rate has been trending upwards since 2007 while its neighbouring provinces of British Columbia, Manitoba and Alberta have seen reductions over the same time period (see Figure 1).

Figure 1. Collision Fatality Rates in Western Canadian Provinces 2002-2010



Aim

Alcohol-related crashes are the leading contributor to fatalities in Saskatchewan. On average 54 victims lose their lives each year while 110 sustain serious injuries from alcohol-related collisions. The numbers of people who die from alcohol-related collisions represent about 43 percent of the total traffic fatalities in the province. Data from the Coroners office, where fatally injured drivers are actually tested for alcohol, indicate that about 86% of dead drivers who had some alcohol in their blood were over the legal limit (i.e., BAC over 0.08) and 12% had low BACs (CCMTA, 2013). According to a recent MADD Canada report, (Solomon et al, 2012) Saskatchewan exceeded the national average when alcohol-related crash deaths were considered. On a per capita basis, Saskatchewan was ranked first among Canadian Provinces with 8.44 impairment deaths per 100,000 population, as compared to the national average of 3.18 impairment deaths per 100,000 population. This major concern for the province and has prompted the Saskatchewan government to hold hearings as to how these dismal traffic safety record can be reversed. The aim of this paper is to shed more light on the characteristics of drivers involved in alcohol-related fatal crashes, particularly those who survive these crashes, a group that has not been the subject of significant exploration..

Method

The data on alcohol-related crashes and the characteristics of the drivers involved (age, gender, number of vehicle occupants, types of persons injured, type and number of vehicles involved, location, driver action prior to crash, etc.) were obtained from Saskatchewan's Traffic Accident Information System (TAIS) which is managed by Saskatchewan Government Insurance (SGI). These data were merged with driver records data on various types of traffic convictions to enable an exploration of the driving habits of these drivers before and after their involvement in alcohol-related crashes.

Results

In Saskatchewan, between 1996 and 2009, there were 18,960 collisions where a driver had been drinking resulting in 12,143 injuries and 771 deaths. The data were sub-divided by type of collision, single or multiple vehicle, injury class of the collision and BAC of the driver, high or low Blood Alcohol Content (BAC). High was defined as over the criminal threshold in Canada, 80 mg/dl, with low being above zero and below that threshold. These data are shown in Table 1.

Table 1 Impaired Drivers in Saskatchewan by collision type and outcome 1996 – 2009.

Collision	Vehicles	Driver	High BAC Drivers			Low BAC Drivers		
Type		Status	Collisions	Injuries	Fatalities	Collisions	Injuries	Fatalities
PDO	SMV	Survived	2,672			2,601		
	Multiple	Survived	3,692			2,487		
Injury	SMV	Survived	2,222	3,537		1,753	2,768	
		Unknown	83	126		54	97	
	Multiple	Survived	1,766	3,167		936	1,641	
		Unknown	27	35		13	15	
Fatal	SMV	Killed	243	140	263	66	37	76
		Survived	100	159	103	42	67	44
		Unknown	16	24	21	9	15	14
	Multiple	1 Killed	103	155	155	36	55	54
		Both Killed	30	83	31	9	22	10
Total			10,954	7,426	573	8,006	4,717	198

The High BAC Group (HBG) accounted for 58% of the collisions, 61% of the injuries and 74% of the alcohol impaired collisions in the dataset. In the HBG 41, 56 and 73 percent of the property damage, injury and fatality collisions respectively were single motor vehicle collisions while in the Low BAC Group (LBG) percentages are 51, 66 and 72.

Of all the alcohol related collisions 36% (6,704) occurred on a rural highway. These collisions accounted for 56% of all injuries and 89% of all fatalities. The suggestion being that impaired driving collisions may be a largely urban issue in terms of numbers of collisions, when looking at severity rural higher speed roads are accounting for a majority of the negative health outcomes.

Fatally injured impaired drivers

The 366 fatally injured drivers who had been drinking 14 drivers had a BAC over zero and less than .04 mg/dl (low), the administrative threshold in Saskatchewan, 21 of the drivers were between .041 and .08 mg/dl (medium) and 331 had a BAC over the Canadian criminal threshold of .08 mg/dl (high). In the low group, 21% of the drivers were 25 years of age or younger, 36% of drivers were between 26 and 45 and 43% were 46 and older. In the medium BAC group, the age breakdown was 67%, 19% and 14% for each age group. In the high BAC group the age breakdown was 36%, 42% and 22% respectively.

The fault status of fatally injured drivers was examined from the claims database. A number of the unknowns result from out of provinces drivers. As can be seen in Table 2, overall 94% of drinking drivers we judged to be at least 50% at fault in the collision. A majority of the drivers were over the Canadian criminal limit for alcohol and a majority of all the drivers who had been drinking were deemed to be at least 50% at fault.

Table 2 At fault status of fatality injured driving drivers, 1996-2009.

	Collision Responsibility			All	For those for which Responsibility is known
	50 pecent or more at fault	Not at fault	Missing data from Claims		
	N	N	N	N	(% at-fault)
< 0.04	11	0	3	14	100%
0.041-0.08	10	2	9	21	83%
>0.08	192	11	128	331	95%
All	213	13	140	366	94%

Surviving and Non-Surviving Drivers

A sub-set of the data was created looking at Saskatchewan drivers who had an alcohol related collision and had three years driving experience pre and post collision. This dataset contains records on 4,883 drivers. This database includes records on about 25% of the drivers who had been drinking and were in a collision between 1996 and 2009.

Of all the drivers in the database, 22% were female and 78% male. These drivers were involved in 95 property damage collisions, 4,319 injury collisions and 465 fatal collisions. In the previous 3 years they were involved in 19 property damage, 1,193 injury collisions and 7 fatal collisions. During the three years following the alcohol involved collision these drivers were involved in 17 property damage collisions, 610 injury collisions and 9 subsequent fatal collisions.

Of the 4,429 surviving drivers of an alcohol involved collision, 22% were female and 78% were male. These drivers were involved in 4,409 collisions, 112 properly damage collisions, 4,181 injury collisions and 116 fatal collisions. These collisions involved 6,999 injuries and 223 deaths. In the previous 3 years these drivers were involved in 1,582 property damage collisions and 290 collisions. In the subsequent 3 years, these drivers were involved in 981 property damage collisions, 163 injury collisions and 3 fatal collisions.

Table 3. Surviving drivers in alcohol related collisions 1996-2009

	3 yrs prior			Alcohol related collision			3 yrs after		
	SEVERITY			SEVERITY			SEVERITY		
	PDO	Injury	Fatal	PDO	Injury	Fatal	PDO	Injury	Fatal
Drivers	1222	275	0	108	4240	116	800	162	3
Collisions	1582	290	0	112	4181	116	981	163	3
Injuries	0	420	0	0	6999	223	0	246	1
Fatalities	0	0	0	0	0	124	0	0	3

Of the surviving 4,429 drivers, 1,721 received 2,117 traffic offence tickets as a result of the collision (this does not include any criminal code charge that may result from the impaired driving charge) for a rate of .48 tickets per drivers. In the previous 3 years 3,138 drivers received 7,499 tickets for a rate per driver of 1.7. In the subsequent 3 years, 2,350 of these same drivers received 4,773 traffic offence tickets for a rate of 1.1 per driver. Of the traffic summons issued in the 3 years prior to the alcohol collision, 42% were for *speeding*, 11% for *no or inappropriate licence,* 10% for *non-wearing of sea belt* and 6% for *drive unregistered vehicle*. The remaining offences were spread across a number of other traffic offences. The pattern was very similar for the 3 year period post collision. The tickets issued at the time of the collision showed a different pattern, with 30% for *without due control*, 16% for *no or inappropriate licence*, 11% for *fail to report collision* and 9% for *drive unregistered vehicle*.

In the database there were 336 fatally injured drivers involved in 333 fatal collisions with 408 fatalities and 280 injuries. These drivers were involved in 112 previous property damage collision and 26 injury collisions. Of these drivers, 166 received 423 traffic offences tickets for a rate of 1.3 per driver. There was a similar pattern of traffic offences, with 52% being for speeding, 8% for not wearing a seatbelt and 7% for driving an unregistered vehicle.

Table 4. Non-surviving drivers 1996-2009

	3 yrs prior			drivers with A-R collision		
	SEVERITY			SEVERITY		
	PDO	Injury	Fatal	PDO	Injury	Fatal
Drivers	80	25	0	0	0	336
Collisions	112	26	0	0	0	333
Injuries	0	33	0	0	0	280
Fatalities	0	0	0	0	0	408

There was no discernible difference between surviving drivers and non-surviving drivers in the year of the vehicle being driven at the time of the alcohol related collision in question. In collisions where the driver did not survive, 71% were single vehicle collisions, and 26 were two vehicle collisions, while in the case of surviving drivers only 52% of collision involved a single vehicle and 40% had 2 vehicles involved.

Not surprisingly, the collisions involving non-surviving driver occurred at higher speeds, with 39% happening on a roadway with an 80 kph posted speed limit and 37% occurring on roads where the posted limit was 100 or 110. In the case of the surviving drivers, the posted limit was 50 kph in 36% of the cases, 20% occurred on roadways posted at 80 kph and only 16% occurred on roads where the limit was 100 or higher.

Fatally injured drivers were more likely to be alone, 67% versus 61% for surviving drivers. A non-surviving driver was more likely to be driving a pickup truck, 37% compared to 29% for surviving drivers. For surviving drivers, 59% were in automobiles compared to 42% for fatally injured drivers. This may in part reflect the relative safety records of the different types of vehicles in questions. This is an open question that bears more examination.

The driver actions of the surviving and non-surviving drivers were somewhat different. In the former group, 40% *lost control*, 18% were in a *rear end collision*, 11% in a *right angle collision* and 10% hit a *fixed object*. The latter group 60% were *lost control* collisions and 14% were *head on* collisions. At the time of the collision 57% of the fatally injured drivers were not using safety equipment, with only 15% of the surviving drivers not using the safety equipment. However, caution need be taken in interpreting this difference as only 14% of dead drivers equipment use was unknown but 44% of the surviving drivers equipment use was unknown. This likely is the result of differences in level of investigations in fatal and non-fatal collision and may also be impacted by treatment requirements at the scene.

Of the drivers killed in the alcohol related collision, 10% had been involved in an alcohol related collision previously. In the case of the surviving drivers, 20% had a prior alcohol related collision and 10% had another alcohol related collision within subsequent 3 years.

Conclusions and Discussion

There are a number of differences found between collisions where the driver survived or did not, most of which are explained by the circumstances of the collision in terms of urban and rural locations, vehicle protection levels and driver action. Further examination is required to assess if these drivers in alcohol related collisions have higher rates of traffic offence tickets in the period prior to the collision.

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Road traffic accidents and psychotropic medication use in the Netherlands: Results from a case-control and a case-crossover study

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Abstract

Background
The consumption of psychoactive medications can influence people's motor and cognitive performances and, therefore, impair the ability to drive safely.

Aims
To evaluate the risk of having a motor vehicle accident (MVA) while exposed to psychotropic medications by means of a case-control and a case-crossover study, and to compare the outcomes of these two studies in order to evaluate the effects of different study designs on the MVA risk estimate.

Methods
A record-linkage database was used to perform a case-control and a case-crossover study, in the Netherlands, between 2000 and 2007. The data came from three sources: a pharmacy prescription database, a police traffic accident database, and a driving license database. The following psychotropic medicine groups were examined: antipsychotics, anxiolytics, hypnotics and sedatives, and antidepressants stratified into selective serotonin reuptake inhibitors (SSRIs) and other antidepressants.

Results
3963 cases and 18828 controls were included in the case-control analysis. A significant association was found between MVA risk and exposure to anxiolytics [Adj. odds ratio (OR) = 1.54 (95%CI: 1.11-2.15)], and SSRIs [Adj. OR=2.03 (95%CI: 1.31-3.14)]. In the case-crossover analysis, 3786 cases were included. This latter did not show any statistically significant association between psychotropic medication exposure and MVA risk [e.g., SSRIs - Adj. OR=1.00 (95%CI: 0.69-1.46); Anxiolytics - Adj. OR=0.95 (95% CI: 0.68-1.31)].

Discussion and conclusions
Case-control and case-crossover analyses showed different results. These divergent results can probably be explained by the differences in the study designs. Given that the case-crossover design is only appropriate for short-term exposures, it can be concluded that this approach is probably not the most suitable one to investigate the relation between MVA risk and psychotropic medications, which, on the contrary, are often used chronically.

Introduction
Driving a motor vehicle is a complex task that involves several psychomotor and cognitive skills (de Gier, Alvarez, Mercier-Guyon, & Verstraete, 2009). Some commonly prescribed medications can influence cognitive and psychomotor functions and, therefore, impair the ability to drive safely (de Gier et al., 2009; Drummer, 2008).

The risk of experiencing a road traffic accident while exposed to psychotropic medications has often been estimated by means of pharmacoepidemiological studies and, in particular, mainly by case-control and case-crossover studies (Orriols et al., 2009). The results of these studies have frequently shown a positive association between the risk of having a motor vehicle accident (MVA) and the exposure to certain groups of psychoactive medications (e.g., benzodiazepines, benzodiazepine-like substances, tricyclic antidepressants) (Orriols et al., 2009; Raes, van den Neste, & Verstraete, 2008; Walsh, de Gier, Christopherson, & Verstraete, 2004) but, in some cases, their findings have been rather controversial. For instance, in 1997 Hemmelgarn et al. performed a case-control study which showed that elderly drivers exposed to long half-life benzodiazepines (BZDs) were significantly associated to the risk of having an MVA within the first week of BZD use (Hemmelgarn, Suissa, Huang, Boivin, & Pinard, 1997), but, on the contrary, in 1998, the case-crossover study of Barbone et al. found no increased traffic accident risk associated to BZD use in individuals ≥ 65 years old (Barbone et al., 1998). A similar discrepancy was also described in the study of Hebert et al. which showed an increased MVA risk in case of long half-life BZD elderly users by applying a case-control approach, but no association was found by using a case-crossover analysis (Hebert, Delaney, Hemmelgarn, Levesque, & Suissa, 2007).
The divergences in the outcomes of the above-mentioned pharmacoepidemiological studies could be explained by the use of different study designs, namely the case-control and the case-crossover designs.

Aims

The aim of this study was to evaluate the risk of having an MVA while exposed to some psychotropic medication groups (which are known to be related to driving impairment (Barbone et al., 1998; Movig et al., 2004; Orriols et al., 2009; Walsh et al., 2004)) by means of a case-control as well as a case-crossover study, and to compare the results in order to evaluate whether the outcomes of these two pharmacoepidemiological designs would lead to analogous traffic accident risk estimates.

Methods

Data sources

A record-linkage database was used to perform a case-control and case-crossover study in the Netherlands, between 2000 and 2007. In brief, a Trusted Third Party performed the linkage between the PHARMO (*PHARMO Institute*), the Dutch Traffic and Navigation Authority (DVS) (*Dienst Verkeer en Scheepvaart - DVS*), and the Dutch Road Transport Authority (RDW) (*Rijks Dienst Wegverkeer - RDW.*) databases, which provided pharmacy prescription data (in particular, the following details were available: dispensing date, the prescribed dosage, the dispensed quantity and the estimated duration of use), traffic accident data, and driving license records, respectively.

Case-control study – Definition, and inclusion and exclusion criteria

Cases were defined as adults (≥ 18 years), who had a traffic accident between 2000 and 2007 and were driving, and received medical assistance. Cases were restricted to those subjects who were found negative for alcohol use (if no data on alcohol use was available, cases were excluded). Controls were defined as adults (≥ 18 years), who had a driving license and had no traffic accident during the study period. Four controls were matched for each case; the matching was by sex, age within five years, postcode, and date of the accident.

Case-crossover study – Definition, and inclusion and exclusion criteria

Cases were defined as drivers who had an MVA attended by the Dutch police during the above-mentioned study time-frame. Subjects were excluded if they were ≤ 18 years old at the time of the accident (i.e., index date) and if they tested positive for alcohol or no alcohol test data was available. Lastly, subjects were excluded if their medication history in the 18 months preceding the index date was not available. The case window was defined as the week before the index date whereas the control window was defined as the same week one year before the index date in order to control for possible seasonal and weather variations which could play a causal role in traffic accidents.

Selected medication groups

The following psychotropic medication groups were included: antipsychotics (ATC code: N05A), anxiolytics (ATC code: N05B), hypnotics and sedatives (ATC code: N05C), antidepressants stratified in selective serotonin re-uptake inhibitors (SSRIs) (ATC code: N06AB) and other antidepressants [i.e., non-selective monoamine re-uptake inhibitors (ATC code: N06AA); monoamine oxidase A inhibitors (MAOs) (ATC code: N06AG); other antidepressants (ATC codes: N06AF and N06AX)].

Medication exposure

Cases and controls (controls: case-control study only) were considered to be exposed if the medication was used during the week before the accident date (i.e., index date). Exposure was considered to start the day after the dispensing date. If the medication exposure ended 2 days before the index date, the subjects were still considered as exposed.

Mono-therapy was defined as the use of only one study medication and combination therapy was defined as the concomitant use of at least two study medicines.

In order to evaluate the effects of the user type on the results of the case-crossover design, 2 types of exposure were examined: 1) All exposed individual: subjects who were exposed to a driving impairing medication in the week before the index date and also used the same medication in the 6 months before the index date (i.e., subjects who used a psychotropic medicine on a regular basis during the 6 months preceding the traffic accident); 2) Acute users: subjects who used a driving impairing medication in the week before the index date, but did not receive any prescriptions for the same medication in the 6 months before the initiation of the therapy (i.e., subjects who initiated their therapy in the week before the MVA and were not exposed to this medication in the 6 months before the initiation of the therapy).

Statistical analysis

The statistical analysis was performed by using the statistical package SPSS (SPSS 16.0 for Windows and SPSS 18.0 for Windows).

Descriptive statistics was used to examine both accident and demographic characteristics of cases and controls.

Logistic regression analysis was used to calculate the odds ratio (OR) of a traffic accident after exposure to the study medications. 95% confidence intervals (CIs) were calculated for all ORs to establish whether the findings were statistically significant. ORs were adjusted for psychotropic drug poly-pharmacy because it is well known that the concomitant use of medications can increase the risk of adverse effects, medicine interactions and, consequently, lead to an increased MVA risk (Drummer, 2008; Movig et al., 2004; Ravera, Visser, de Gier, & de Jong-van den Berg, 2010).

Results

The study population of the case-control study consisted of 3963 cases and 18828 controls whereas the study population of the case-crossover study consisted of 3786 cases.

The results of the case-control study are reported in Table 1 whereas the outcomes of the case-crossover study are reported in Table 2 (NB: the outcomes of descriptive statistics analyses are not reported here).

Table 1. Exposed subjects [cases (N=3963) and controls (N=18828)], crude and adjusted ORs for road-traffic accident in different psychotropic medicine group users.

MEDICINE GROUP	CASES (Exposed) (%)	CONTROLS (Exposed) (%)	Crude OR (95% CI)	Adj. OR (95% CI)
Antipsychotics				
All exposed individuals	20 (0.50)	96 (0.51)	1.01 (0.62-1.63)	1.31 (0.71-2.42)
Anxiolytics				
All exposed individuals	94 (2.37)	310 (1.65)	**1.46 (1.16-1.85)**	**1.54 (1.11-2.15)**
Hypnotics				
All exposed individuals	76 (1.92)	273 (1.45)	**1.34 (1.04-1.74)**	1.39 (0.94-2.07)
SSRIs				
All exposed individuals	92 (2.32)	252 (1.34)	**1.76 (1.38-2.24)**	**2.03 (1.31-3.14)**
Other antidepressants				
All exposed individuals	40 (1.01)	146 (0.78)	1.32 (0.93-1.88)	1.45 (0.81-2.58)

Table 2. Exposed subjects (N=3786) in the case and control windows, crude and adjusted ORs for road-traffic accident in different psychotropic medicine group users, stratified by all exposed individuals and acute users.

MEDICINE GROUP	CASE WINDOW (Exposed) (%)	CONTROLWINDOW (Exposed) (%)	Crude OR (95% CI)	Adj. OR (95% CI)
Antipsychotics				
All exposed individuals	18 (0.50)	23 (0.60)	0.76 (0.41-1.41)	0.68 (0.34-1.35)
Acute users	1 (0.02)	1 (0.002)	0.97 (0.06-15.52)	0.97 (0.06-15.52)
Anxiolytics				
All exposed individuals	92 (2.40)	94 (2.50)	0.95 (0.71-1.27)	0.95 (0.68-1.31)
Acute users	13 (0.34)	11 (0.29)	1.15 (0.51-2.56)	0.97 (0.40-2.33)
Hypnotics				
All exposed individuals	75 (2.00)	85 (2.20)	0.86 (0.63-1.17)	089 (0.63-1.25)
Acute users	6 (0.16)	11 (0.29)	0.53 (0.20-1.43)	0.39 (0.12-1.24)
SSRIs				
All exposed individuals	92 (2.40)	87 (2.30)	1.03 (0.76-1.38)	1.00 (0.69-1.46)
Acute users	7 (0.18)	5 (0.13)	1.36 (0.43-4.28)	1.29 (0.29-5.79)
Other antidepressants				
All exposed individuals	40 (1.10)	45 (1.20)	0.86 (0.56-1.33)	0.88 (0.53-1.46)
Acute users	3 (0.08)	3 (0.08)	0.97 (0.20-4.81)	0.97 (0.20-4.81)

Discussion and conclusion

To the best of our knowledge, this is one of the few studies that evaluated and highlighted the possible impact of two different epidemiologic study designs (i.e., case-control and case-crossover) on the association between MVA risks and psychotropic medication exposure in the same study population.

The outcomes of the case-control study indicated that there was a statistically significant association between the risk of having a road traffic accident and the exposure to anxiolytics and SSRIs [Anxiolytics: Adj. OR=1.54 (95% CI: 1.11 – 2.15); SSRIs: Adj. OR=2.03 (95% CI: 1.31 – 3.14)] whereas the results of the case-crossover study did not show any significant increase in MVA risk associated with the exposure to the selected psychotropic medicine groups [e.g., All exposed individuals: Anxiolytics: Adj. OR=0.95 (95% CI: 0.68 – 1.31); SSRIs: Adj. OR=1.00 (95% CI: 0.69 – 1.46)]

The discrepancies between the outcomes of the case-control and case-crossover studies could be attributed to the choice of the study design. The case-crossover design is a commonly used scientific method to investigate whether a certain event was triggered by something unusual that happened just before the event itself (Maclure & Mittleman, 2000). The case-crossover is a matched case-control study, but it only involves cases and each case serves as its own control (Maclure & Mittleman, 2000). Because of this peculiarity, the case-crossover design controls for stable subject-specific covariates and it overcomes control selection bias (Maclure, 1991). However, this type of design requires that the exposures are brief and their effects transient (Maclure, 1991; Strom, 1994). Considering that psychotropic medications are often used on a regular and chronic basis (Del Rio & Alvarez, 1996; Hebert et al., 2007; Ravera et al., 2010), it can be speculated that, in the present study, one of the most important assumptions of the case-crossover design was not met and, therefore, the choice of this study design was probably not appropriate.

On the contrary, it could be conceivably hypothesised that the case-crossover analysis should be limited to intermittent users of the selected medication groups. However, it is important to note that, in the current study, this restriction led to a consistent loss of cases and, even if the ORs calculated for this specific group of users (i.e., acute users) were more similar to the ORs obtained by applying the case-control technique, it can be speculated that our study did not have adequate statistical power to detect the association between incidental psychotropic medication users and MVA risks (Hennekens & Buring, 1987; Strom, 1994).

Besides the above-mentioned points, there could also be other possible explanations for the discrepancies among the findings of the two designs that were used. As some authors have also pointed out (Hebert et al., 2007; Hernandez-Diaz, Hernan, Meyer, Werler, & Mitchell, 2003; Maclure, 1991; Maclure, 2007; Schneeweiss, Sturmer, & Maclure, 1997), possible reasons for different results between case-crossover and case-control studies may be related to selection bias of the control-person-time (i.e., our selected control-person-time did not properly represent the population-time that generated the cases due to, for example, possible divergences in the driving patterns between the case and control times), confounding by indication (no information was available on what medical condition the psychotropic medications were prescribed for, and, consequently, we could not account for the confounding effect of the disease), different effects of the medication at different points in time (e.g., different estimates in relation to therapy duration and/or prior exposures (Guess, 2006)), time-varying within-subject confounding factors (e.g., fluctuations in disease severity, co-morbidities, etc.), and time trend bias (i.e., changes in the prescribing patterns of the medications of interest).

In conclusion, our investigation showed that different study designs gave different answers to the same research hypothesis, in the same population. Considering that every study design has design-specific assumptions, and strengths and limitations, it could be assumed that our analyses actually tested distinctive causal hypotheses and focused on different aspects of psychoactive medication use and MVA risk (Hebert et al., 2007; Hernandez-Diaz et al., 2003; Maclure, 2007). As a consequence, it seems reasonable to conclude that each pharmacoepidemiological design may be appropriate only in certain settings and under specific assumptions (Hernandez-Diaz et al., 2003). Therefore, if possible, multiple designs and analyses should be used to investigate the different aspects of factors that can play a role in traffic safety while driving under the influence of psychotropic medications.

Disclaimers

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Developing targets and strategies for school-based injury prevention programs to reduce alcohol associated transport risks

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Abstract

Background There is considerable and ongoing debate about the role and effectiveness of school-based injury prevention programs in reducing students' later involvement in alcohol associated transport injuries. Most relevant literature is concerned with pre-driving and licensing programs for middle age range adolescents (15-17 years). This research team is concerned with prevention at an earlier stage by targeting interventions to young adolescents (13-14 years). There is strong evidence that young adolescents who engage in unsafe and illegal alcohol associated transport risks are significantly likely to incur serious related injuries in longitudinal follow up. For example, a state-wide representative sample of male adolescents (mean age 14.5 years) who reported being passengers of drink drivers were significantly more likely to have incurred a hospitalised injury related to traffic events at a 20 year follow up.
Aim This paper reports on first aid training integrated with peer protection and school connectedness within the Skills for Preventing Injury in Youth (SPIY) program. A component of the intervention is concerned with providing strategies to reduce the likelihood of being a passenger of a drink driver and effectiveness is followed up at six months post-intervention.
Method In early 2012 the study was undertaken in 35 high schools throughout Queensland that were randomly assigned to intervention and control conditions. A total of 2,521 Year 9 students (mean age 13.5years, 43% male) completed surveys prior to the intervention.
Results Of these students 316 (13.7%) reported having ridden in a car with someone who has been drinking. This is a traffic safety behaviour that is particularly relevant to a peer protection intervention and the findings of the six month follow up will be reported.
Discussion and conclusions This research will provide evidence as to whether this approach to the introduction of first aid skills within a school-based health education curriculum has traffic safety implications.

Introduction

Young Australians are over-represented in national road fatality and injury statistics making them particularly vulnerable road users. Despite representing only 16 percent of the Australian adult population, 17 to 25 year olds make up 25 percent of motor vehicle fatalities and serious injuries (Road Traffic Authority, 2007). Studies have shown that the crash risk of young drivers is affected by the presence of same-age passengers and the risk significantly increases with each additional passenger (Chen, Baker, Braver & Li, 2000; Simons-Morton, Lerner & Singer, 2005). Bingham, Shope, Parow and Raghunathan (2008) found that although young drivers were relatively less likely to be involved in alcohol-related crashes, passenger presence significantly increased the likelihood that a crash involving alcohol would result in a fatality.

To address the risks faced by young drivers, Graduated Driver Licensing systems (GDL) have been introduced throughout Australia. GDL systems act as a form of exposure control by including a range of requirements and restrictions which allow novice drivers initial experience under conditions that involve lower risk. For example, in Queensland, passenger restrictions are imposed on young novice drivers during the night in which they are only permitted one passenger under the age of 21, with the exception of family members (Queensland Government Department of Transport and Main Roads, 2011). There is a growing body of literature supporting the effectiveness of GDL systems in reducing young driver crashes (Hartling et al., 2009; Williams, Tefft & Grabowski, 2012). Research has shown that GDL systems which include night-driving and passenger restrictions appear to be effective (Morrisey, Grabowski, Dee & Campbell, 2006; Rice, Peek-Asa & Kraus, 2004). Unfortunately, young drivers have reported high rates of violating GDL requirements (Masten & Hagge, 2004), in particular passenger restrictions (Williams et al., 2007). Therefore, while GDL systems partially address passenger-related risks greater emphasis needs to be placed on evidence-based interventions that improve the inherent safety of young passengers through early interventions.

A study conducted by the authors explored the impact of a curriculum-based injury prevention program, Skills for Preventing Injury in Youth (SPIY), on passenger-related risk taking and injuries (Chapman, Buckley & Sheehan, 2012). This study reported on results of an early trial of the SPIY program which included 10 schools with participation from approximately 450 Year 9 students. Students who received the program were less likely to report passenger-related risk taking behaviours six months post the intervention, while these behaviours increased among control students. During focus groups intervention students indicated that they were less likely to take risks, and provided examples of ways in which they could avoid risky passenger situations. The current study extends on previous research using a large scale randomised control trial of the school-based intervention, SPIY program and cluster analysis.

Skills for Preventing Injury in Youth (SPIY)

The SPIY program is a theory-based intervention designed to increase a number of protective factors that may reduce adolescent risk taking behaviour and injury, including first aid skills, peer-protective behaviour, school connectedness and individual attitude change. The program is targeted at 13 to 14 year olds and involves eight (weekly) 60 minute lessons which are delivered by Year 9 teachers. Implementation of the SPIY Program involves a full day training session in SPIY curriculum delivery, school connectedness and CPR certification for all teachers delivering the program. The facilitation of SPIY within the classroom encourages considerable group interaction and is based on effective cognitive behavioural strategies. Each lesson involves three core components – scenario based learning, practical first aid activities and critical thinking skills in prevention. The Theory of Planned Behaviour (Ajzen, 1991) is a fundamental component of the SPIY curriculum and it operationalises protective factors in adolescent friendship and in changing adolescents' attitudes and beliefs about injury risk behaviours to value safer behaviours.

An evaluation has shown significant and meaningful reductions in risk taking behaviour (i.e., interpersonal violence, alcohol use and transport-related risks) (Buckley, Sheehan & Shochet, 2010). Findings from surveys conducted pre and post intervention indicated a decrease in self-reported risk taking for the intervention group and an increase in the comparison group. Results have also shown favourable reports on the delivery of first aid material and demonstrated that first aid skills can be effectively implemented within the high school setting and produce multiple benefits for adolescents (Buckley & Sheehan, 2009).

Research aim

This study aimed to examine the impact of SPIY on passenger-related risk taking. This study builds on a previous trial of the SPIY intervention and aims to address earlier limitations in order to strengthen the evidence that school-based programs may be an important means of increasing adolescent passenger safety.

Method

Participants

In total 2521 students aged 13-14 years old from 35 secondary schools in southeast Queensland and the Queensland Central Coast participated in the study. The schools, consisting of state-funded, Catholic and independent schools, were randomly assigned to either a SPIY intervention condition (n = 17) or control condition (n = 20). Control schools were offered the program for use following the research project. At baseline, the mean age of students was 13.5 years, 1515 students (42% male) participated in the surveys from intervention schools and 1006 students (35% male) participated from control schools. At six month follow up 2118 students participated in the survey, a retention rate of 84%. The mean age of participants at six month follow up was 14.0 years. Matched data from baseline to six month follow up was available for 1689 students of which 901 students were from intervention schools and 788 students were from control schools.

Procedure

Ethical approval for the conduct of this research was obtained from relevant research committees, schools and parents prior to inviting students' participation. Students with parental consent who were present on the data collection days gave their informed written consent prior to participation in the research. Students were administered self-report surveys (30 minutes) during class time. Individual names were not required to maintain confidentiality. However, a linking code (e.g., mother's name and the first letter of the student's name) was used to match the pre and post intervention surveys.

Measures

Demographic items

Demographic information that was collected included students' age, sex and ethnic background. The Index of Relative Socio-Economic Advantage/Disadvantage, as derived from the 2006 Australian Census, was noted for each school. The Index is a rating constructed from attributes of the population in the area, such as educational attainment, income, employment and occupation. Index rating scores range from 1-10, with low values indicating disadvantage and high values indicating advantage (ABS, 2008).

Risk taking

The measure of risk taking behaviour was based on the Australian Self Report Delinquency Scale, ASRDS (Mak, 1993), with adjustments made by Western and colleagues (2003). Each item describes a risk taking behaviour and participants were asked to respond as to whether or not they had engaged in that behaviour in the past three months. One item was included in the current analysis. The item asked whether students had ridden in a car with a drink driver.

Results

Table 1 shows the percentage of intervention and control students by gender who reported change or no change in passenger-related risk taking from baseline and 6 month follow up.

The variables were categorised into three groups which included positive change (i.e., a reduction in riding as a passenger of a drink driver from baseline to six month follow up), negative change (i.e., an increase in riding as a passenger of a drink driver from baseline to six month follow up) and no change over the same period.

	Intervention			Control		
Ridden with drink driver	**% positive change**	**% negative change**	**% no change**	**% positive change**	**% negative change**	**% no change**
Female	9.2	5.8	85.0	5.0	6.3	88.8
Male	7.3	8.4	84.2	7.0	8.0	85.0

Note. Ridden with a drink driver in the preceding 3 months.

Table 1: Change in reports of riding with a drink driver from baseline to 6 month follow up

Differences from baseline to six month follow up between students from intervention and control conditions who reported being passengers of drink drivers were examined using Chi-square analyses. Analyses were differentiated by gender. There was a significant difference between female intervention and control students, with intervention females showing a significant positive change in passenger risk behaviours [$\chi^2(2, N = 959) = 6.38, p = .041$. Standardised residual = 1.7]. As indicated by the percentage change from baseline to six month follow up, female intervention students showed a greater percentage of positive change in reports of being a passenger of a drunk driver than control students.

Among males, there was no significant difference between intervention and control students reported incidences of being a passenger of a drink driver [$\chi^2(2, N = 655) = .075, p = .963$]. As indication by the percentage of positive change, negative change and no change following the intervention, little difference is observed between male intervention and control students reports of being a passenger of a drunk driver.

Discussion

The increased crash risk of young drivers in the presence of same-age passengers is well documented (e.g., Chen et al., 2000). Therefore, greater attention needs to be given to initiatives that improve the inherent safety of young passengers. The results show evidence for school-based injury prevention programs, such as SPIY, to improve the safety of young passengers. Six months following the SPIY program females from intervention schools were significantly less likely to report being a passenger of a drunk driver. The occurrence of riding in a car with a drunk driver also decreased among males who received the SPIY intervention in comparison to the control group. It is encouraging that six months following participation in SPIY, intervention students’ reported involvement in passenger-related drink driving decreased to a greater degree than control students.

Chapman and colleagues (2012) findings from the early trial of the SPIY program, support the current study by reporting that students who received the intervention were less likely to report passenger-related risk taking behaviours six months post the intervention, while these behaviours increased among control students. Although the SPIY program is designed to globally target a reduction in risk taking behaviours and associated injury, the findings suggest that the program can have a positive effect on reducing the occurrence of travelling in a car with a drunk driver. Therefore, evidence-based curriculum interventions may be an appropriate form of targeting the inherent safety of young passengers earlier than GDL systems.

The current findings should be considered in light of some limitations. The present research relied on self-report data, which has potential to be biased by participant recall or inaccuracy. In this study, it was not possible to use independent confirmation or external sources and therefore further research should incorporate objective measures. Another limitation of this study is the single item measurement tool which assessed dichotomously whether participants had travelled in the car with a drunk driver in the previous 3 months. While this measure fails to account for the extent of the outcome behaviour it has the potential to capture all instances of this unsafe behaviour. Further the follow up period of participants was relatively short. To overcome this limitation, there is potential to examine change in this outcome at long term follow up with 12 month data collection in progress.

Despite these limitations, the research documents evidence for a school-based injury prevention program to reduce passenger-related risk taking in comparison to a control group, who showed only a small decline in riding in the car with a drink driver at 6 month follow up. The current study extended previous findings of the SPIY trial by Chapman et al. (2012) using a large scale randomisation control trial of the SPIY intervention. The large scale trial was strengthened by the large sample size and wide diversity of schools. This research supports the need to target strategies aimed at reducing passenger-related risks.

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Female Impaired Drivers: A Review of the Literature and Qualitative Study in Four States

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Abstract

Background
There have been dramatic increases in arrests among female impaired drivers, and smaller increases in alcohol-impaired crashes. Limited progress in reducing this problem, particularly in light of substantial declines among male drunk drivers, warrants further attention and concern.

Aims
The Traffic Injury Research Foundation (TIRF) was contracted by The Century Council to review the literature and conduct a qualitative study on female impaired drivers. The purpose was to determine what is known about this issue, what gaps in knowledge exist, and to begin to address some of those gaps and provide insight into needed strategies to improve the management of these offenders.

Methods
The project methodology was based on a multi-faceted design including a literature review, and the analysis available data sources, focus groups with first and repeat offenders, and key informant interviews with experienced practitioners in four states. Participants in this study included 154 convicted female impaired drivers and 36 criminal justice and treatment practitioners.

Results
The magnitude of this problem has changed in the past decade based on different measures of the problem, although reasons for this are unclear. While female drunk drivers share some common characteristics with males, there are also important differences including patterns of alcohol consumption and alcohol problems, use of drugs, presence of mental health issues, treatment engagement and barriers to treatment entry. Frontline practitioners encounter several challenges in dealing with these offenders including a lack of knowledge about this population, and a lack of targeted programs.

Discussion and conclusions
The findings from this study provide a more complete picture of this problem today and guidance to inform the development of more effective strategies to ensure female drunk drivers are subject to effective and appropriate interventions that reduce offending.

Background

Historically, impaired driving has been considered a predominantly male problem (Mayhew et al. 1990; Kelley-Baker and Romano 2010). However, female involvement in drunk driving has been a source of growing concern since the late 1980s (Argeriou et al. 1986; Underhill 1986) as impaired driving arrest numbers for women and involvement of females in alcohol impaired crashes have increased in North America and elsewhere (Robertson et al. 2011; Tsai et al. 2010; Waller 1997). This issue has recently received further attention as a number of women have been arrested in high-profile drunk driving cases, most notably Diane Schuler who drove, with her children in her van, the wrong way down the Taconic State Parkway in New York and killed eight people (four of whom were children).

Several explanations for this increase have been put forward including changes in the societal roles of women (e.g., more women driving as a result of an increased number of women entering the workforce), changes in social norms that make it more acceptable for women to drink, and changes in social control mechanisms (e.g., more female law enforcement officers and lowering the legal breath alcohol concentration (BAC) limit from 0.10% to 0.08%). Regardless of the cause of the increase, more attention to this issue is warranted to increase understanding of the problem and ways that it can be addressed.

Much of the available research examines male impaired driving offenders who represent the majority of this problem. Limited research has been conducted involving female impaired drivers, and, since much of it was conducted more than twenty years ago, it does not provide an accurate or complete picture of female impaired drivers today. More concerning, it provides limited insight into effective programs and interventions specific to this population.

As such, current gaps in the state of knowledge must be addressed in an effort to better understand the nature of female impaired driving offending, the characteristics of this population, and ways to prevent re-offending using tailored, appropriate and effective interventions.

Aims

To address these existing gaps in knowledge and provide a current snapshot of the female impaired driving problem, the Traffic Injury Research Foundation (TIRF) conducted a two-stage study. The first stage, undertaken in 2011, involved an extensive review of the research literature that focused mainly on North American and some Western studies. The purpose was to determine what was currently known about the problem.

The second stage, conducted in 2012, was designed to further build upon this knowledge base and increase understanding of this problem. There are three main objectives of this latter study. First, it was designed to explore the life histories of convicted female drunk drivers and the ways that their history may contribute to their offending. Second, the study was structured to examine women's subsequent experiences in the criminal justice and treatment systems. Finally, the third objective of this study was to explore the experiences of criminal justice and treatment professionals in supervising this offender population. Collectively, these data can be used to enhance our knowledge of female drunk drivers. It is underscored that this study was designed as a hypothesis-generating exercise as opposed to a hypothesis-testing one[1].

Methods

The literature review included research that pertained to the magnitude of the female drunk driver problem (e.g., self-report data, arrest and conviction data, involvement in impaired driving interventions and alcohol-crash data), the characteristics of these offenders (e.g., demographic information, substance use and mental health issues, criminal history and recidivism), and what is known about effective strategies to manage this population.

A multi-faceted research design was utilized for the second stage of this study. It included focus groups with first and repeat offenders to explore their attitudes, behaviors, characteristics, risks and needs, and pathways to offending as well as their experiences within the criminal justice and treatment systems. Key informant interviews were also conducted with experienced criminal justice and treatment practitioners to identify how female drunk drivers are managed within these systems and what has been learned from their experiences supervising and treating them.

Discussion guides were developed for both offender focus groups and key informant interviews to elicit relevant information regarding priority topics. Guides were peer-reviewed by an experienced researcher and probation officer.

Data were collected between July and November 2012 with cooperation from the National Center for DWI Courts[2] (NCDC) and the American Probation and Parole Association (APPA). Focus groups and interviews were conducted in four states – California, Michigan, Missouri and New York. These states were chosen to provide a geographically representative sample of the United States. Slightly more than half of the offenders who participated in this study were located in urban areas whereas slightly less than half represented rural jurisdictions. In contrast, key informant interviews almost equally represented urban and rural jurisdictions.

Focus group participants were invited to volunteer to participate in the groups by the criminal justice practitioner responsible for their supervision (typically a probation officer) in lieu of a regularly scheduled meeting with the practitioner. Each participant also received information about the group and it was underscored that all information shared during the focus groups would be anonymous and not directly attributed to any individual.

In total, there were 154 convicted female impaired driving offenders (both first and repeat) who participated in 15 focus groups which ranged in size from five to 15 participants. There were also

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[1] Hypotheses can be generated in exploratory research whereas empirical data are gathered to test existing hypotheses in confirmatory research. The current study and its applied methods were conducive to the generation of such hypotheses, rather than testing them. To truly test them (i.e., reject or accept), more data are needed.

[2] Specialty problem-solving courts such as DWI courts and drug courts are more widespread in the United States than in Canada. For more information about these courts please see the National Association of Drug Court Professionals and the National DWI Court Center at www.nadcp.org and www.ncdc.org.

four additional in-depth individual interviews with female drunk drivers that were conducted primarily by phone with one being conducted in-person as well as a select survey of 28 female impaired drivers. Participants ranged in age from late teens to mid-60s, and the number of prior impaired driving offenses varied from one to seven with the average being two or three. Participants equally represented offenders processed in traditional courts and DWI courts.

Two researchers were present in each of these focus groups and they each recorded their own notes to document discussion; interviews were conducted by just one researcher. The use of a recording device and associated software to capture and analyze discussion in each of the groups had been considered as part of the original study design, however, this was not pursued in order to protect and preserve the anonymity of the participants and to ensure a comfortable setting for open discussion to enhance the quality of the data. The data that are reported are estimates that were developed based upon the detailed notes gathered by both researchers reflecting discussion in each of the focus groups. Overall, the notes produced by each researcher were highly consistent and contained similar information and observations.

The key informant interviews involved a total of 36 individuals representing judges (3), defense attorneys (2), probation officers (24), alcohol education providers (3) and treatment counselors (4). The practitioners included in this study represented frontline professionals as well as managers and supervisors. While some practitioners had just two or three years of experience in their field, the majority of them had between ten and 30 years of experience

All of the collected data were used to identify key themes as well as lessons learned, and to formulate recommendations to improve the supervision of these female offenders and the delivery of services to them in the criminal justice and treatment systems. Drafts of this report were peer-reviewed by knowledgeable practitioners and experts in the field to gain their feedback and input on the content of the report and the recommendations put forward.

Results

Literature review. Although female self-report data on drinking and driving and crash data reveal that there has been little change in female involvement in drinking and driving in the past three decades, there has been a dramatic increase in the number of women arrested for drunk driving in just the past decade. Moreover, while male and female drunk drivers share some common characteristics, there are also some important differences. Females are more likely to be single, separated or divorced, and to have custody of children. They also are more likely to suffer from mental health issues such as anxiety or depression, and use drugs in addition to alcohol. More concerning, women experience a more rapid progression of alcohol dependence, and require medical intervention an average of four years earlier than males who are problem drinkers (Gudrais 2011). These differences may have important implications for the delivery of impaired driving interventions and treatment for women.

Focus groups. Several key findings and common themes emerged from the data collected in the four jurisdictions. In terms of the demographics of this offender population, focus group participants ranged in age from late teens to mid-60s, suggesting that women of all ages are involved in impaired driving. Some of these participants did not experience involvement in drinking and driving at a young age, but instead only began to engage in this behavior much later in life. The family background of these women varied considerably as did the level of education that they attained. A majority of the focus group participants indicated they were employed; those who were not reported it was difficult to be hired as a result of prior arrests or because of scheduling demands placed on them in relation to supervision.

More than half of the women were single, separated, or divorced and the majority had children. Approximately one-third of the participants stated that they had some type of support network in the form of either family or friends that enabled them to comply with the demands of parenting, employment and the requirements of supervision. A large majority of women that participated in the focus groups reported that their impaired driving arrest was precipitated by a major life stressor such as a domestic argument, the end of a relationship, the loss of a job or child custody, or the illness or death of a parent or other family member.

Mental health issues were frequently reported with more than half of the focus group participants indicating they had one or more prescription medications for disorders such as anxiety, depression, post-traumatic stress disorder, and bipolar disorder. There were many instances of undiagnosed mental health issues and histories of trauma and/or abuse (both physical and sexual). Illicit drug use was uncommon and less than one-third of the participants reported use of illicit substances of which marijuana and methamphetamines were the most common. Often illicit drug use was connected to a partner or spouse who also used drugs.

With regard to the BACs of focus group participants, a number of women reported that their BAC was shockingly high and BACs of 0.25%, 0.3%, and 0.42% were not uncommon, although, unlike males, among women it was generally a source of shame or embarrassment.

Three different profiles of this population generally emerged:

- Younger women involved in socializing and social activities;
- Recently married women with young children; and,
- Divorced women, “empty nesters”, or women who have a parent with a debilitating health problem or who recently died.

It is estimated that at least one-third of participants spent time in jail or prison (ranging from one week to five years) as a result of their sentence for impaired driving, and/or for subsequent violations of court or probation supervision. With few exceptions, almost all of the women reported that jail and/or prison was a frightening experience that merely desensitized them.

Perhaps most notably, a majority of participants reported that information about the requirements of their supervision, the length of their supervision, their eligibility for certain privileges (e.g., a driver’s license), or the potential consequences for non-compliance generally lacked clarity or were unclear. A large majority of study participants consistently agreed that the level of respect, support, and communication they receive from criminal justice practitioners can make the difference between their success and failure. While an estimated one-quarter of the study participants noted that it was preferable to have a female practitioner supervise them, a larger proportion reported that their ability to develop a good rapport with them was more important.

It is estimated that more than half of the participants reported challenges specifically in relation to compliance with random testing requirements. While almost all of the females participating in this study reported that treatment had a positive impact on their lives, they also identified significant gaps in the treatment system including insufficient and inadequate services and cost.

With regard to their current situation, between one-half and two-thirds of study participants reported having little or no support system that they could rely upon following their impaired driving arrest to help them manage the requirements of their supervision. An estimated three-quarters of women noted that transportation was very challenging.

Undoubtedly, the most prevalent theme that consistently emerged was that women often defined their experiences in the criminal justice and treatment systems in terms of the emotional effects. Overall, findings from key informant interviews were highly similar, and practitioners reported that there are some important differences in the use of supervision and treatment strategies for female impaired drivers.

Discussion and conclusions

There appear to be some distinct differences in characteristics and the experiences of female drunk drivers as compared to their male counterparts. Recommendations include a focus on prevention to target school-aged women with education about drinking and its effects and increased efforts to identify emotional problems, mental disorders, or difficult living circumstances. Improvements to the justice system underscore ongoing accountability, recognition of progress and compliance, flexibility in scheduling and more education for practitioners about addiction and social services. Recommended improvements for the treatment system include more female-only services and opportunities to integrate treatment and real life. The findings from this study provide a more complete picture of this problem today and guidance to inform the development of more effective strategies to ensure female drunk drivers are subject to effective and appropriate interventions that reduce offending.

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Impaired Driving Risk Assessment of First and Repeat Offenders and Knowledge Transfer in Canada

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Background
Risk assessment of first and repeat impaired drivers is a core function of the criminal justice and driver licensing systems in Canada, yet few risk assessment instruments are specific to impaired driver populations. Research on impaired driver risk assessment generally overlooks that assessments are utilized in different systems with different frequency, for different purposes, and that "risk" has different meanings among practitioners, making research difficult to implement. Practitioners are also unfamiliar with this research. Knowledge transfer is essential to ensure that practitioners receive education and research translates into real world benefits.

Aims
The purpose was to provide: i) an overview of risk assessment practices for impaired drivers across Canadian driver licensing and criminal justice systems, ii) a snapshot of knowledge among practitioners, and iii) insight into barriers that inhibit knowledge transfer and ways to address them.

Methods
Focus groups and key informant interviews were conducted with administrative impaired driver program staff and criminal justice professionals in five Canadian jurisdictions. A small survey of justice professionals representing six jurisdictions was also conducted. Results were analyzed using a Delphi panel approach and peer review.

Results
Results identified some strengths with risk assessment practices in the driver licensing system; fewer strengths were evident in the justice system. Concerns about current risk assessment practices include training, types of instruments used, caseloads, and the measurement of program outcomes and effectiveness. Strategies to improve practices and overcome barriers to knowledge transfer were recommended.

Discussion and conclusions
More research on first and repeat impaired driver risks and risk assessment instruments is needed. Increased efforts among researchers to disseminate research to practitioners, or partner with those who can, would strengthen risk assessment practices. This is essential given the number of impaired drivers processed annually and the profound costs of delivering interventions that fail to address the risk that offenders pose.

Background

Although a general decreasing trend in the number of persons killed in a traffic crash involving a drinking driver has occurred in Canada between 1995 and 2008, the progress achieved since the late 1990s has been nominal and the number of persons killed and injured in crashes involving drinking drivers remains high. In 2009, 32.3% of fatally injured drivers in Canada had a blood alcohol concentration (BAC) over the legal limit of .08 (Mayhew et al. 2011). In addition, in 2009, 714 people were killed in Canada in road crashes that involved a driver who had been drinking and approximately 2,913 drivers (excluding Newfoundland and Labrador) were involved in alcohol-related serious injury crashes in Canada (Mayhew et al. 2011).

Growing economic challenges mean that jurisdictions are seeking ways to use resources more effectively and efficiently to best manage drunk drivers to protect the public. The use of research-based risk assessment tools and practices is one means to attain this goal and a linchpin to making the best use of available resources. There are two types of systems that process impaired drivers in Canada and rely upon, to varying extents, information stemming from risk assessments of these drivers: 1) the criminal justice system; and, 2) remedial impaired driver programs that are an administrative sanction imposed by the driver licencing authority. Although the term “risk” has different meanings among different practitioners, and the goals of risk assessment practices within these two systems differ substantially, both approaches to the risk assessment of impaired drivers are extremely relevant to reduce impaired driving.

Aims

The purpose of this study was to provide an overview of risk assessment practices in Canada for impaired drivers, and to provide a snapshot of the practices used by driver licencing and criminal justice practitioners. Its goals were to summarize current risk assessment practices and to describe the different ways that impaired drivers are assessed for risk in both systems. The study also included some recommendations to inform and/or guide future efforts to develop or improve best practices related to risk assessment in both systems.

Methods

The study was comprised of focus groups involving 28 remedial impaired driver program practitioners and criminal justice professionals in Alberta, Ontario, Quebec and Nova Scotia as well as conference calls with a judge and a probation officer in the Yukon and Northwest Territories. Topics of discussion in the focus groups were identified based on a best practices review of the literature and discussion guides for this purpose were developed. The study also included a survey of 65 justice professionals (Crown attorneys, defence attorneys and probation officers) representing six jurisdictions that responded to the survey (Alberta, Manitoba, Saskatchewan, New Brunswick, British Columbia and Ontario). A draft version of the survey was reviewed by experienced criminal justice professionals before it was finalized and fielded across Canada. Results from the focus groups were analyzed using a Delphi panel approach and peer review. Survey results were analyzed using univariate and bivariate analyses.

Results

Remedial programs and services. Historically, staff members may or may not have been required to hold a university degree, diploma or certification in a relevant discipline but they often possessed vast personal and/or practical experience that was relevant to the job. Conversely, today, a university degree, a diploma or certification is a standard requirement for all new hires (either undergraduate and/or post-graduate) in these programs. A minimum level of practical experience and regular accreditation may also be requirements.

The level of hands-on training and supervision that new staff members receive varies substantially across jurisdictions. Orientation, training and mentoring is very structured in some jurisdictions; efforts are more ad hoc in others. Continuing education opportunities are often a function of resources. Perceptions among staff members regarding their level of knowledge, particularly with regard to appropriate theories of behaviour, the validity and reliability of risk assessment instruments used, and the interpretation of results can vary across jurisdictions. Of interest, staff members generally agreed that the ability to properly score the instruments is paramount, particularly because the interpretation of scores can be subjective and based heavily on a clinician's judgment. It is unclear whether and to what extent the knowledge of staff members regarding the use of risk assessment instruments is objectively measured at hiring or on an ongoing basis.

Based upon focus group discussions with staff, program participants across Canada are perceived to share some common characteristics, including: a majority of offenders do complete the requisite program; offenders would not otherwise seek treatment services if not for their conviction and are "embarrassed" (that they were caught); most delay participation in programs; offenders initially minimize their substance use; and, they engage in unlicenced driving to some extent. Differences include: breath alcohol concentration (BAC) levels ranging from low to high; a range of reported drinking behaviours with different diagnoses; different levels of involvement with drugs; and, different stages of change at the time of program entry.

The number of participants served by remedial impaired driver programs varies from a few hundred offenders each year in smaller jurisdictions up to several thousand offenders in larger jurisdictions. In recent years, it appears that the number of participants has grown across jurisdictions and this is believed to be a function of changes in impaired driving laws and administrative penalties in particular. It is estimated that 70-85% of offenders who are mandated to participate in these programs and services do so.

The risk assessment instruments that are utilized by remedial impaired driver programs across Canada are selected according to available research evidence and the specific goals of the program. Due to the strengths and weaknesses associated with many of them, a majority of jurisdictions rely on several instruments during the assessment process to produce a more complete picture of an offender. A key factor in the selection of instruments is cost due to limited resources although there is a strong desire to adopt instruments that have been rigorously evaluated on this specific population.

In most jurisdictions, assessment outcomes are used to assign offenders to appropriate services and develop a tailored treatment plan to address their specific needs. Offenders may play an active role in its development to encourage a higher level of commitment and ensure objectives are achievable. There may be additional recommendations for offenders post-program that are forwarded to the appropriate licencing authority, as required, such as alcohol/drug counselling services, self-help groups, medical consultation, employment counselling or mental health services. However, remedial program agencies have no authority or mechanisms to follow-up with offenders and the only consequence for those who fail to complete requirements is that they are not re-licenced.

A key limitation of the assessment process reported by staff members is that they are often unfamiliar with the outcomes associated with the assessments they conduct and recommendations that they make in each case. This makes it difficult for them to determine whether their assessment and recommendations reduced future offending or for agencies to evaluate their programs.

According to focus group participants, there is strong consensus regarding the strengths associated with impaired driver remedial programs and services in Canada, as well as some limitations. Strengths exhibited by some programs include: an individualized approach and diversity of available services; well-designed, research-based programs and services; quality assurance protocols; well-trained clinicians and program staff; affiliation with research institute or university; and, communication with other agencies. Limitations exhibited by some programs include: the quality of risk assessment instruments; access to information; availability of time; availability of resources; lack of transportation options; implementation of new legislation; inconsistent awareness among justice professionals; and, lack of tailored remedial programs for youth.

Justice system results. Approaches to sentencing impaired drivers, according to the nature of the offence and the BAC level, were fairly consistent across jurisdictions, although the level of consistency generally declined as the severity of the offence increased. National results revealed that: 51% of respondents in the six jurisdictions reported that the typical sentence for a first offence with a BAC below 0.15% was a fine of $1,000-$1,500 with a one-year driving prohibition; 40% of respondents indicated a fine of $1,200-$1,800 and a one-year driving prohibition for a first offence with a BAC above 0.15%; and, approximately one-third (34%) of respondents reported that the typical sentence given to a repeat offender was a fine, jail and probation.

More generally, knowledge and training among attorneys about impaired drivers is generally inconsistent and often a function of the types of educational opportunities that are available. According to justice practitioners who participated in focus groups, very few impaired drivers undergo risk assessment in the criminal justice system and a majority of respondents were unaware of the tools used to assess risk in their respective jurisdictions.

When assessments are ordered, the Level of Service Inventory (LSI) instrument is used and the assessment is part of the pre-sentence investigation. It may be completed by a social worker, a treatment professional, or possibly a probation officer. Focus group participants estimated that only 5% of offenders are assessed; survey results showed that nationally, 71% of respondents estimated that 0-10% of their impaired driver cases involved a risk assessment. There are a number of factors that can impede the volume of or quality of risk assessments for accused drivers/offenders. These include: a lack of resources (74%), available time (65%) and financial costs (63%) and more than half of respondents (62%) nationally reported that they believe a larger percentage of impaired driving offenders should undergo a risk assessment.

A minority of respondents was aware of the risk assessment instruments used in their jurisdictions, and even smaller proportions were aware if these instruments account for important differences across offenders relating to gender, cognitive deficits, ethnicity, psychiatric disorders or level of education. Approximately half (51%) of respondents nationally reported that they did not know what kinds of information are generally gathered about offenders to inform a risk assessment with approximately 40% identifying criminal history and self-reported information. In sum, important gaps were observed in relation to the knowledge among criminal justice professionals concerning the types of information used for risk assessment purposes.

Within the criminal justice system, assessment outcomes are important and, when available, these outcomes are often utilized in sentencing. Almost half (48%) of respondents reported that it is important that assessment reports are available in relation to sentencing. Nationally, a strong majority (89%) of respondents reported that criminal history is given the greatest weight to inform sentencing recommendations and/or sentencing. When queried about the most useful factors to predict recidivism among impaired drivers, 92% of respondents nationally reported that drinking/drug history was the most useful factor, followed by criminal history (85%).

Recommendations for remedial programs include: improvements in the quality of risk assessment instruments utilized, increased training for staff, a greater emphasis on prevention activities; and encouraging the use of best practices. Recommendations for the justice system include the consistent use of alcohol interlock devices; efforts to better target unlicenced drivers, creating affordable options for offenders and increased communication and information-sharing.

Conclusions

More research on first and repeat impaired driver risks and risk assessment instruments is needed to fill important knowledge gaps. In addition, increased efforts among researchers to disseminate findings to practitioners, or partner with those who can, would strengthen risk assessment practices. This is essential given the number of impaired drivers processed annually and the profound costs of delivering interventions that fail to address the risk that offenders pose.

Principle barriers to knowledge transfer of research regarding risk and risk assessment include: the lack of time, the lack of resources, the lack of access to publications, journals and academics themselves, and the heavy caseloads that define the environment that criminal justice and driver licencing practitioners encounter on a daily basis. More widely available research would help increase understanding of risk in relation to impaired drivers and inform approaches to the use of these instruments. This is an essential priority in light of the sheer number of impaired drivers that are processed in each system annually and the profound economic and social costs.

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Reforming Canada's new drug-impaired driving law: The need for per se limits and random roadside screening

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Abstract

Context
The issue of drug-impaired driving has recently risen to prominence in Canada. Survey data, roadside screening studies and post-mortem reports indicate that driving after drug use is commonplace and is now more prevalent among young people than driving after drinking. Although drug-impaired driving has been a criminal offence since 1925, police were not given specific means of enforcing the law until 2008. Unfortunately, the 2008 *Criminal Code* amendments, which authorized police to demand Standardized Field Sobriety Tests and Drug Recognition Evaluations, have not had their desired effects. The measures have proved to be costly, time-consuming and cumbersome, and are readily susceptible to challenge in the courts. Accordingly, the charge rates for drug-impaired driving remain extremely low.

Objectives
To review alternative enforcement models for drug-impaired driving that have been adopted in other jurisdictions, and to recommend a model that will improve apprehension and conviction rates and thereby deter drug-impaired driving. The model must be consistent with Canada's social, political and constitutional frameworks.

Key Outcomes
Canada should adopt a system of random roadside saliva screening, similar to the model used in Victoria, Australia. For drivers who test positive, more sensitive evidentiary testing should be conducted at a police station, after the driver has been afforded the right to counsel.

Discussion and conclusions
The 2008 *Criminal Code* amendments were an important first step, but will not significantly improve apprehension or conviction rates for drug-impaired driving. It is preferable to set *per se* limits for the most commonly-used drugs, enforceable through a system of screening and evidentiary tests. This will be more efficient and cost-effective, and will result in more reliable evidence for criminal trials. Although this system will inevitably be subject to constitutional challenge, existing case law suggests that it should be upheld as a reasonable limit on constitutional rights.

Introduction
Drug-impaired driving is an issue that warrants serious attention in Canada. Driving after drug use has become more common during the past 15 years (Mann et al., 2010; Simpson, Singhal, Vanlaar, & Mayhew, 2006). Perhaps of greatest concern, several provincial, regional and national surveys indicate that many young people routinely drive after drug use (Asbridge, Poulin, & Donato, 2007; Patton, Mackay, & Broszeit, 2005; Poulin & McDonald, 2007). Indeed, more young Canadians report driving after using cannabis than after drinking (Paglia-Boak, Adlaf, & Mann, 2011, p. 15). For example, in the *Canadian Addiction Survey*, 39.8% of those aged 15-24 reported driving within two hours of using cannabis during the past 12 months, compared to 20.9% who reported driving under the influence of alcohol (Canada, Minister of Health, 2007, p. 95). In addition, the mean number of times that

respondents admitted to driving “under the influence of cannabis” in the past year was 10, compared to 1.6 for alcohol.

These survey data are reaffirmed by roadside surveys (Brault, Dussault, Bouchard, & Lemire, 2004; Beirness & Beasley, 2011) and post-mortem toxicology tests (Mercer & Jeffrey, 1995; Bouchard & Brault, 2004). For example, a 2011 study involving almost 6,000 drivers who were fatally injured from 2000 to 2007 found that 54.6% were positive for alcohol and/or drugs (Beasley, Beirness, & Porath-Waller, 2011, p. 1). Alcohol alone was present in 21.9% of the cases, drugs alone were present in 18.5%, and alcohol and drugs were present in 14.2%. In the drug-positive cases, 41% were positive for two or more drugs (p. 10). The high rates of concurrent drug and alcohol use and of poly-drug use are troubling because these substances’ combined effects may be multiplicative. Thus, it seems clear that drug-impaired driving merits legislative attention.

Prior to the 2008 *Criminal Code* amendments, the prosecution of drug-impaired driving cases was typically based on the arresting officer’s testimony regarding the accused’s driving, behaviour, demeanor, and statements. However, even when an accused was obviously impaired, and there was evidence of recent drug use, it was typically still necessary to bring expert evidence linking the drug use to the accused’s impairment. As one judge remarked, “the preferred practice [is] for the Crown to call expert medical or scientific evidence regarding the effects of drugs.... the court cannot take judicial notice of the effects of various drugs” (*R v Rosskoph*, para. 18). This made drug-impaired driving an onerous and uncertain offence to prosecute. Indeed, a 2003 Department of Justice report indicated that prosecuting a drug-impaired driving offence based on the observations of a non-expert police officer (such as one on routine patrol) was “nearly impossible” (Department of Justice, 2003, p. 4).

The 2008 *Criminal Code* amendments

The difficulties in prosecuting drug-impaired driving offences prompted Parliament to introduce two new enforcement measures in 2008. First, police are authorized to demand a Standardized Field Sobriety Test (SFST) if they reasonably suspect that a driver has any alcohol or drugs in his or her body. This is a relatively low threshold test, which is based on the same grounds as the demand for breath tests on approved screening devices (ASDs). As with ASD tests, the results of SFSTs can only be used to screen drivers at roadside and to provide grounds for demanding subsequent evidentiary breath tests or Drug Recognition Evaluation (DRE).

Second, the 2008 amendments established formal procedures for gathering evidence of drug use and impairment from suspected drug-impaired drivers. They authorized police to demand a DRE from a driver who they have reasonable grounds to believe has, within the preceding three hours, driven while impaired by a drug or a combination of drugs and alcohol. The results of the DRE are admissible at trial, if the DRE was conducted in accordance with the requirements of the relevant regulations and the driver was afforded the right to counsel.

Developed and used in the United States since the 1970s, DRE is designed to determine if an individual’s ability to drive is impaired by one of seven categories of drugs.[1] The *Criminal Code* provides that DREs can only be conducted by an “evaluating officer,” who must be accredited by the International Association of Chiefs of Police. The process of training,

[1] The seven categories of drugs are: central nervous system depressants; inhalants; dissociative anesthetics; cannabis; central nervous system stimulants; hallucinogens; and narcotic analgesics.

certifying and maintaining the certification of evaluating officers is rigorous and expensive. It was estimated that the cost of training each evaluating officer in Canada is $17,000, and that a total of 800 officers have been trained. However, with transfers and retirements, there were only 491 evaluating officers conducting DREs as of September 2012.[2]

DRE consists of several physiological and divided attention tests, at the conclusion of which the evaluating officer completes a written opinion as to whether the suspect's ability to drive is impaired and, if so, by what category of drugs. The officer can then demand a sample of blood, urine or saliva for analysis. A drug-impaired driving charge will only proceed to trial if the bodily sample confirms the evaluating officer's conclusions. It has been reported that a typical DRE in Canada lasts 30-45 minutes, and entails the collection of over 100 separate pieces of information (Porath-Waller, Beirness, & Beasley, 2009, p. 517).[3]

While DRE may be accurate in identifying drug-positive suspects, it is of far less value in proving that the suspect's driving ability was in fact impaired by drugs. Most of the steps in the DRE focus on drug presence and not on the impairment of driving ability.[4] Unfortunately, there are no studies on the relationship between failing a DRE and actual impairment of driving skills, as measured by laboratory, driving simulator, and closed access roadway tests. This problem has not gone unnoticed by the Canadian courts.

DRE in the Canadian courts

The Canadian courts remain sceptical about the link between the mere presence of drugs in a driver's system and the actual impairment of driving ability. In a recent Saskatchewan case (*R v Perillat*), the investigating officer smelled an "overwhelming odour" of marijuana coming from the accused's vehicle. The accused admitted to smoking marijuana 2½ hours earlier, and showed the officer the "roach" on her centre console. The results of both the SFST and DRE were indicative of marijuana use, which was confirmed by a urine test. However, at the accused's trial for impaired driving, the judge was not convinced that her ability to drive was actually *impaired* by marijuana. The judge explained:

> But at its best, Constable Schaefer's evidence convinces me that the accused had used marijuana at some point prior to her being stopped at the police check stop that evening and that she still had some of it in her system at the time he did his Drug Recognition Evaluation on her at the police station. What his evidence does not convince me of is that at the time she was driving, her ability to operate a motor vehicle was impaired by marijuana.
>
> …
>
> Constable Schafer's evidence does not explain the accused's test results and how they relate to the accused's ability to drive a motor vehicle or how they relate back to the time of driving. Without testimony on these points, I am left with many questions. For example, what signs of impairment would one expect to see in someone who has been using marijuana? How long after using marijuana would you expect to see these signs and how long would they last? Can the results of Drug Recognition Evaluation tests taken over one and one-half hours after the time of driving be reliably related back to the time the accused pulled into the check stop? Was the accused's performance in some of the tests just as consistent with someone who has poor balance or poor co-ordination as it was with someone who had used marijuana? (*R v Perillat*, paras. 24, 26)

[2] Email communication from D Beirness, Senior Research and Policy Analyst, CCSA, to A Murie, CEO, MADD Canada (24 September 2012).
[3] This does not include the time necessary to conduct the preliminary roadside SFST, transport the suspect to the police station, or allow him or her to consult with counsel. When these aspects are included, the process takes close to two hours from testing to completion.
[4] It is only the four divided attention tests (the walk-and-turn, the one-leg-stand, the Romberg balance, and the finger-to-nose tests) that directly assess the impairment of skills thought to be important for driving.

In acquitting the accused, the judge also stressed the absence of any evidence that the accused had been driving in an erratic, improper or impaired manner.

Criminal Justice Statistics

Even with approximately 500 officers conducting DREs, the number of persons charged with a drug-impaired driving offence has been disappointing. There were 944 drug-impaired driving charges in 2011, which constituted only 1.4% of all impaired driving charges (60,414) (Statistics Canada, 2013). While the total number of persons charged with a drug-impaired driving offence increased by almost 15% from 2009 to 2010, it increased by less than 4% from 2010 to 2011. This means that only a tiny percentage of drug-impaired drivers are ever charged. The Canadian Centre for Substance Abuse has estimated that drivers make 15.6 million trips per year after using cannabis (CCSA, online). Even if all 944 drug-impaired driving charges involved cannabis, a driver would have had to make more than 16,500 trips after using cannabis to have been charged with a single drug-impaired driving offence.[5]

Alternatives to DRE

In addition to the behavioural-based enforcement approach used in Canada, drug use can be detected through the testing of blood, saliva or urine. Ideally, the testing protocol for drugs would parallel the existing *Criminal Code* breath-testing provisions for alcohol. That is, preliminary screening would be conducted at roadside, with further evidential testing conducted at the police station after the accused has been afforded the right to counsel. However, testing for drug impairment is more complex than testing for alcohol impairment. First, not all drugs necessarily or consistently cause impairment. Second, the non-active metabolites of some drugs stay in a driver's system long after their impairing effects have worn off. Third, until recently, there was no quick, inexpensive and non-invasive means of screening drivers for drug use at roadside. Finally, while there is a broad consensus on the impairing impact of alcohol at various BAC levels, views differ regarding the specific level at which the various drugs impair driving ability. Consequently, the scheme for enforcing alcohol-impaired driving cannot simply be adopted for drug-impaired driving.

Zero tolerance and per se limits

Other jurisdictions have approached this problem in two main ways. In some jurisdictions, it is an offence to drive with any amount of a specified drug in one's system (the "zero tolerance" approach). At least a dozen American states have adopted this approach (Lacey, Brainard, & Snitow, 2010). When combined with chemical testing, zero tolerance laws have been shown to increase charge rates for drug-impaired driving. Both police and prosecutors report that zero tolerance laws have made it easier to prosecute drug-impaired driving cases. These laws provide a clear and unambiguous message, and can be enforced objectively by police without extensive specialized training. However, a zero tolerance approach may not garner much public or political support in Canada, given that drivers may test positive for a drug even though their ability is not impaired. In addition, a zero tolerance law may be perceived as a back-door attack on drug use, rather than a drug-impaired driving measure.

Given the potentially negative policy implications of a zero tolerance law in Canada, the preferable alternative is to establish criminal *per se* limits for given drugs, at a level at which the driving ability of most drivers would be impaired. This approach allows the government

[5] Admittedly, these 15.6 million trips include people who were not impaired by cannabis at the time of driving. However, it excludes those who were impaired by other drugs.

to focus on the drugs that are most commonly used, most likely to cause impairment, and that can be detected at roadside by means of a relatively quick and inexpensive test.

Enforcing per se limits

It is not enough to prohibit driving with a set amount of drugs in one's body. As with alcohol-impaired driving, the police need the authority and means to conduct toxicological drug tests on drivers. Considering other demands on criminal justice resources, police need enforcement procedures that are straightforward and cost-effective, but nevertheless constitutionally valid. In some jurisdictions, toxicological tests are conducted in a relatively small number of cases. For instance, although Arizona has a zero tolerance law, the likelihood of a driver being chemically tested for drugs is minimal (Lacey et al, 2010). Police must have probable cause to stop the vehicle and have grounds to initiate a drug-impaired driving investigation.[6] This is a protracted and exacting process, and depends heavily on the officer's personal observations. Such a system is unlikely to dramatically increase drug-impaired driving charges.

In contrast, several European countries (Beirness, Swan, & Logan, 2010) and Australian states have introduced random roadside screening for specified drugs. In these jurisdictions, the police typically have authority to demand that any driver take a saliva test at roadside. If the driver tests positive, he or she will then be required to undergo additional, evidentiary testing. Like random breath testing (RBT), which also exists in these jurisdictions, random drug screening allows the police to test a large number of drivers in a relatively short period of time. For drivers who test negative, there is only a modest delay and slight inconvenience.

The Australian state of Victoria provides a useful model for Canada. The *Road Safety (Drugs Driving) Act, 2003* and *Road Safety (Drugs) Act, 2006* prohibit drivers from operating a motor vehicle with any level of methamphetamine, THC or MDMA (ecstasy) in their systems. The legislation authorizes police to randomly demand an oral fluid screening test from any driver at roadside. If the driver tests positive for any of the target drugs, he or she is required to accompany police to a testing vehicle where a second saliva sample is taken. The second sample is tested by a specially trained and qualified police officer. If the second sample also tests positive for a targeted drug, it is sent to a laboratory for confirmatory analysis, and the driver is immediately prohibited from driving for a specified time. The driver will only be charged if the laboratory analysis confirms the presence of a targeted drug. If the second test is negative, the driver will be released, after a total detention of approximately 15 minutes. Preliminary analysis of Victoria's drug-testing framework has shown positive results. All 489 drivers prosecuted pursuant to the legislation between December 2004 and December 2006 were convicted (Boorman & Owens, 2009, p. 21).[7]

Nevertheless, the approach in Victoria would need to be modified to be consistent with Canada's legal and social framework. First, as described, a zero tolerance approach is likely to be seen as back-door enforcement of the federal drug offences, and would capture drivers who are not actually impaired by the drug while driving. Consequently, *per se* limits would need to be established. Second, Canadian police are not generally equipped with roadside testing vehicles, so suspected drug-impaired drivers would need to be taken to a police station for further evidentiary testing. Moreover, drivers would need to be informed of and allowed to exercise their constitutional right to legal counsel before evidentiary testing took place. Finally, the current Canadian law does not allow for the random roadside screening of drivers

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[6] The driver must exhibit visible signs of impairment but have a low BAC, thereby ruling out alcohol as the source of impairment; or there must be other obvious signs of recent drug use (eg drug paraphernalia).
[7] Another 17 were convicted of refusing to provide a sample.

for either alcohol or drugs.[8] The authors have repeatedly called for RBT legislation (Solomon, Chamberlain, Abdoullaeva, Tinholt & Chiodo, 2011a; Solomon, Chamberlain, Abdoullaeva, & Tinholt, 2011b), and do not repeat those arguments here. The case for random drug screening is as compelling as the case for RBT. Indeed, there may be less opposition to drug screening than to RBT, given that it would target drugs that are already being used illegally.

Constitutional Issues

Like most changes to enforcement practices, the random stopping of drivers and random saliva screening for drugs will undoubtedly give rise to challenges under the *Canadian Charter of Rights and Freedoms*. The most likely challenges would be based on section 9 (arbitrary detention), section 10(*b*) (the right to counsel), and section 8 (unreasonable search or seizure). As we have explained elsewhere, random toxicological screening will undoubtedly be found to be arbitrary and a violation of the right to counsel (Solomon et al, 2011a). However, consistent with the Supreme Court's decisions regarding roadside ASD testing and SFST, these drug-related violations should be justified under section 1 of the *Charter* as reasonable limits "prescribed by law [that] can be demonstrably justified in a free and democratic society"[9] (*R v Hufsky*; *R v Ladouceur*; *R v Thomsen*; *R v Orbanski*).

There is somewhat less certainty as to whether random saliva screening would violate the right to be free from unreasonable search and seizure. This will depend on whether drivers have a reasonable expectation of privacy with respect to saliva testing. While there is undoubtedly some expectation of privacy, this expectation is qualified given that driving is a licensed activity that involves considerable risk and requires that one's ability to drive not be impaired (*R v Wise*). Further, providing a saliva sample at roadside is minimally intrusive. The test does not involve pain, discomfort or indignity, and reveals no personal information about the driver except for the presence of certain drugs in his or her system. The test is used solely for screening purposes and is not admissible in criminal proceedings. When put in the context of the random screening procedures used at every Canadian airport, at border crossings, at many courts and other government facilities, which commonly involve physical searches of one's person and luggage, we believe that random roadside saliva testing should be found to be a reasonable search under the *Charter* (Chamberlain, Solomon & Kus, 2013).

Conclusion

The sharp increases in drug-impaired driving pose a major traffic safety risk in Canada, particularly for young drivers. Although the enactment of SFST and DRE legislation gave police authority to investigate drug-impaired driving, it has proven to be inadequate. Thus, the federal government should move from its exclusive reliance on SFST and DRE, and work toward enacting a system of roadside saliva testing for the most commonly-used illicit drugs. The accuracy and affordability of the drug screening tests will likely continue to improve and Canada should take advantage of these advances. Once sufficient scientific consensus has been reached, Canada should enact appropriate *per se* limits that are akin to the .05% and .08% BAC limits for drinking and driving.

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[8] In order to demand a breath test on an ASD or SFST, police must reasonably suspect that a driver has alcohol or drugs in his or her body. *Criminal Code*, section 254(2).

[9] The test for justifying *Charter* violations is set out in *R v Oakes*, [1986] 1 *Supreme Court Reports* 103. It involves five elements. (i) Is the infringement prescribed by law? (ii) Does it respond to a pressing and substantial legislative objective? (iii) Is the measure rationally connected to the objective? (iv) Does it infringe *Charter* rights as little as possible? (v) Do its positive effects outweigh its deleterious effects?

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Increasing alcohol interlock participation rates in Canada: Best practices and the effects of insurance

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Abstract

Context
Interlocks are an effective means of reducing recidivism among impaired driving offenders. However, interlock programs have suffered from low participation rates, and thus have not achieved their traffic safety potential. Moreover, many offenders who do not participate choose instead to drive without a licence or insurance. These drivers are overrepresented in fatal crashes and expose the public to the risk of uncompensated losses and injuries.

Objectives
To review the alcohol interlock programs across Canada and identify possible barriers to participation. Having determined the provinces with the highest participation rates, this paper identifies the program features that are most conducive to increasing participation.

Key Outcomes
The provinces with the highest interlock participation rates generally have the most inclusive mandatory programs that apply to the greatest number of offenders. In these jurisdictions, enrollment in the interlock program is a condition of relicensing, preventing offenders from simply "waiting out" the hard licence suspension period. Most of these provinces also reduce the minimum licence suspension period to encourage offenders to install an interlock.

Discussion and Conclusions
The provinces should design interlock and related policies to maximize participation rates. This includes making participation mandatory for all federal impaired driving offenders and shortening the provincial suspensions that otherwise apply. The total costs of an impaired driving conviction, including insurance, should be kept at a level that does not encourage offenders to forego the interlock program and drop out of the licensing system altogether.

Introduction

Alcohol interlocks have been recognized as an effective and important component of the strategy to deal with impaired drivers (Beirness & Marques, 2004; National Highway Traffic Safety Administration [NHTSA], 2010a). Research indicates that impaired driving offenders with interlocks on their vehicles have significantly lower recidivism rates than offenders who do not. For example, a New Mexico study found that offenders with an interlock had a 66% lower recidivism rate than comparable offenders serving hard licence suspensions (Roth, Voas, & Marques, 2007, p. 24). A Florida study found that offenders who installed an interlock had an 80% lower recidivism rate over a two-year period than offenders who received only a licence suspension (Voas, Tippetts, Fisher, & Grosz, 2010, p. 1426). Similar positive results have been reported in Canada (Voas, Marques, Tippetts, & Beirness, 1999).

Increasing interlock participation rates also has significant traffic safety benefits. For instance, a recent study in the state of Washington estimated that if the participation rate of first offenders had been 100%, rather than the actual rate of 24%, the offenders' two-year cumulative recidivism rate would have fallen from 9.1% to 3.2% (McCartt, Leaf, Farmer, & Eichelberger, 2012, p. 16). The study also indicated (p. 18) that if all drivers in the United States with a single impaired driving conviction within the past three years had been kept from driving after drinking, nearly 650 crash deaths would have been prevented in 2010.

Moreover, increasing interlock participation decreases the risk that impaired driving offenders will drive while suspended. As a group, suspended drivers have very high rates of alcohol-related fatal and personal injury crashes (Scopatz, Hatch, DeLucia, & Tays, 2003, p. 8). An Ontario study reported that crashes involving drivers suspended for impaired driving were 3.5 times more likely to be fatal than crashes among the general driving population (MADD Canada, 2007, p. 21). These suspended drivers were also 16.3 times more likely to have been impaired when involved in a fatal or personal injury crash (p. 31).

Finally, because suspended drivers are uninsured, they expose others to the risk of losses for which there is no third-party compensation (Solomon, Hanc, Ricci, & Visser, 2005, pp. 38-40). In contrast, drivers subject to interlock orders are much less likely to drive while impaired (Elder et al., 2011, p. 367) and are at least partially insured against third-party liability if they cause a crash. Unfortunately, interlock programs in Canada and other jurisdictions have struggled with low participation rates (Beirness & Marques, 2004, p. 301; Elder et al., 2011).

The legislative framework governing impaired driving in Canada

The federal government has used its constitutional authority over criminal law to enact the *Criminal Code* impaired driving offences and their penalties. The federal offences of impaired driving, driving with a BAC above .08%, and refusing to participate in a required impairment test carry a minimum $1,000 fine and one-year driving prohibition for a first offence. In 1999, this provision was amended to allow the one-year minimum prohibition to be reduced to three months for interlock participants. In 2001, the *Criminal Code* was further amended to permit the minimum driving prohibition to be reduced to six and twelve months, respectively, for second and subsequent offenders enrolling in an interlock program.

However, the administration of interlock programs falls to the provinces, which can impose administrative sanctions pursuant to their constitutional authority over driver and vehicle licensing. Although most provinces have some form of interlock program, they vary greatly in terms of inclusion criteria, the duration of interlock orders, and conditions for relicensing (Chamberlain & Solomon, 2012). The provinces also have authority over automobile insurance. In some provinces, automobile insurance is administered by a public agency and is tied to vehicle and driver licensing. In others, the government simply regulates the private insurance industry. In either case, the provinces have authority over insurance rates.

Interlock participation rates in Canada

Table 1 sets out the number of interlock orders as of December 31, 2011 and the number of drivers convicted of a federal impaired driving offence from July 1, 2010 until June 30, 2011. These figures were used to provide an estimate of the percentage of offenders enrolled in interlock programs in each jurisdiction. Because the reporting periods for interlocks and convictions are not coextensive, the estimated participation rates are only approximations.

Table 1: Interlock participation rates among federal impaired driving offenders in Canadian provinces and territories

Province/ Territory	Interlocks: 31/12/2011	Impaired driving convictions: 2010/11	% of offenders in interlock programs
AB	2,180	5,738	38%
BC	1,188	5,591	21%
MN	155	1,771	9%
NB	137	1,209	11%
NL	89	608	15%
NS	599	1,586	38%
NT	0	158	0%
NU	0	66	0%
ON	6,209	13,414	46%
PE	85	321	26%
QC	9,533 *	6,483	139%
SK	400	2,672	15%
YU	24	167	14%
Canada	**20,559**	**40,144**	**51%**

* Quebec had far more federal offenders in its interlock program at the end of 2011 than convictions in 2010/2011, due to the significant number of long-term interlock orders and the very high participation rates.

Key features in provinces with higher participation rates

Outlined below are aspects of interlock programs that appear to have been conducive to participation, focusing on provinces with participation rates over 20%. While our review is based on the programs as of December 2011, significant changes have been made since. For example, Alberta, Manitoba and Prince Edward Island have expanded their mandatory programs to include all alcohol-related *Criminal Code* impaired driving offences.

Mandatory interlock program

As their name suggests, mandatory interlock programs require offenders to install an interlock at some time prior to regaining full licensure. Offenders cannot simply “wait out” the hard suspension period, an option that many would otherwise take to avoid the cost and inconvenience of installing an interlock (NHTSA, 2010a, p. 26). Not surprisingly, the provinces with the highest participation rates had the most inclusive programs. In British Columbia and Ontario, the interlock program was mandatory for all federal impaired driving offenders. In Alberta, Nova Scotia, Prince Edward Island, and Quebec, only repeat offenders, those with a BAC above .16%, or other “high-risk” offenders were required to participate. In most provinces, the minimum interlock order was one year for first offenders, and two or three years for repeat offenders. A lifetime interlock order applied after a third offence in Ontario and a fourth offence in Manitoba (Chamberlain & Solomon, 2012, p. 349).

Reduced hard suspension for interlock participants

Evidence suggests that offenders are less likely to participate in an interlock program if it is preceded by a lengthy hard licence suspension (NHTSA, 2010a, p. 26). Accordingly, reduced provincial licence suspensions can be used to motivate offenders to enter a program. This was recognized by the federal government when it reduced the mandatory federal driving prohibitions for interlock participants in 1999 and 2001. Most of the provinces with higher participation rates shortened the provincial licence suspensions for some categories of federal offenders who enrolled in their interlock programs. Nova Scotia and Prince Edward Island reduced the provincial licence suspension for all federal interlock participants. This incentive was not available to the more serious categories of impaired driving offenders in Quebec and Ontario, and was discretionary in Alberta. These limits on reduced provincial licence suspensions may reflect deference to victims or government concern about being viewed as "going soft" on impaired driving offenders (Beirness & Marques, 2004, p. 306).

Enhanced enforcement
Early relicensing alone may not be sufficient to motivate offenders to participate in an interlock program. Many offenders choose to avoid the expense and inconvenience of using an interlock device and drive while suspended (NHTSA, 2010a, p. 6). The laws against driving while suspended need to be strengthened and more effectively enforced. This may include: enhanced vehicle impoundment and immobilization legislation; more effective licence verification programs; and broader police powers to demand and, if appropriate, seize drivers' documentation. If offenders perceive a greater risk of apprehension for driving while suspended, they will probably be more willing to enroll in an interlock program.

All of the provinces with higher interlock participation rates, and most others, have some form of vehicle impoundment program for suspended driving. However, current mechanisms for identifying suspended drivers, even if they are stopped by the police, appear to be largely ineffective. The provincial licensing agencies and police do not consistently seize the licences of drivers who are suspended. A Moncton, New Brunwisk study found that 91% of suspended drivers stopped at a roadside check program provided police with an apparently valid driver's licence (Malenfant, Van Houten, & Jonah, 2002, pp. 441-42). The ease with which offenders can forgo the interlock program and drive while suspended significantly undermines the interlock programs and, more broadly, the impaired driving laws (Voas et al., 2010; NHTSA, 2010a).

Licensing measures are also required to prevent interlock participants from driving vehicles not equipped with an interlock. Of the provinces with higher interlock participation rates, Alberta, British Columbia, Ontario, and Prince Edward Island indicate on the driver's licence that he or she is subject to an interlock order (MADD Canada, 2008, p. 17). Thus, unless the driver is using a forged or another person's licence, the police will be alerted to the driver's status and can take appropriate action if the vehicle is not equipped with an interlock.

Insurance rates
While the cost of installing and maintaining an interlock is often cited as a barrier to participation (NHTSA, 2010b, p. 27), less attention has been paid to insurance costs. Insurance is generally expensive in Canada, particularly in the jurisdictions with private systems. For example, the estimated cost of insurance for a 22-year-old with four years' driving experience and a clean record would be $3,065 in Toronto, $2,822 in Calgary, and $1,659 in Halifax (MADD Canada, 2012). The cost of insurance for impaired driving offenders should not create a financial incentive to drop out of the licensing system and drive illegally (Scopatz, et al., 2003, p. 30). Offenders in interlock programs should be offered substantially reduced premiums, both to encourage participation and reflect the reduced risks they pose while driving an interlock-equipped vehicle.

In Quebec, the province with the highest interlock participation rate, automobile insurance is provided by a public agency. The insurance surcharges for a *Criminal Code* impaired driving conviction are very modest ($300, $350 and $400 for a first, second and third conviction).

Similarly, in British Columbia, which also has a public system, the surcharge for a first offence is $905 for three years (MADD Canada, 2012). In contrast, if the 22-year-olds described above had an impaired driving conviction, their private insurance premiums would increase to roughly $10,000-$20,000 in Toronto (326%-653%), $7,500 in Calgary (266%) and $9,000 in Halifax (542%).

The relatively high interlock participation rates in these three jurisdictions, despite high insurance costs, require some explanation. First, while Ontario's, Alberta's and Nova Scotia's interlock participation rates are relatively high, they are still below 50%. Second, a significant number of interlock participants apparently do not inform their insurers of their convictions. Since the companies do not routinely check offence records, these offenders may be able to avoid the costly surcharges (Murie, personal communication, May 20, 2013). However, if offenders knowingly misinform their insurers, their coverage will be largely negated. Thus, while these offenders may benefit from participating in the interlock program and nominally remain in the licensing system, they expose others to the risk of losses for which there is only limited coverage. In any event, more offenders would likely enroll in an interlock program and inform insurers of their convictions if the costs were not prohibitive.

Other factors that may affect interlock participation rates

Several other factors warrant brief mention. All of the provinces have some kind of remedial education or treatment program that must be completed prior to or while participating in the interlock program (Chamberlain & Solomon, 2012, p. 351). If these remedial programs are costly and require completion before entering the interlock program, some offenders may be reluctant to participate (Voas & Marques, 2003). Participation will also be affected by the availability of interlock service providers and the required inspection schedule. If offenders have to drive long distances to have the interlock serviced, they will be less likely to participate in and successfully complete the program (DeYoung, 2002, p. 480).

Summary and conclusions

This review suggests that certain program features and related policies will encourage increased interlock participation. Participation tends to be higher if the program is mandatory for all offenders and provides a reduced hard licence suspension as an incentive. More effective licence check and vehicle impoundment programs are needed to discourage offenders from driving illegally. Finally, if total relicensing costs are unaffordable due to insurance costs, interlock installation/maintenance fees, and other remedial program charges, large numbers of federal impaired driving offenders will abandon the licensing system.

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Risk factors associated with recurrent DUI offenses in Brazil

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Abstract

Background: Alcohol in blood is a major factor for traffic accidents; high blood alcohol concentrations (BAC) increase the risk of involvement in offenses, and it is hypothesized that traffic injuries and casualty rates are partly attributed to recurrent offending behavior.

Aim: To analyze and compare risk and protective factors among Brazilian repeat DUI offenders in 2009/2010.

Methods: Cross-sectional study with 12,204 DUI offenders from the State Traffic Department, using descriptive statistics and Poisson regression analysis. Drivers, age, sex, education level, time license to drive and license category were assessed. Drivers were considered repeat offenders if convicted of DUI more than once among 2009/2010.

Results: 538 drivers (4.41%) were repeat offenders. The risk factors with the highest rates were age between 41 and 50 (PR=3.41), being licensed for 12 years or more (PR=1.86), having a motorcycle/car/truck license (PR=1.36), having a restricted license for psychological reasons (PR=1.33), and driving a truck or similar at the moment of notification (PR=1.08). Protective factors were female sex (PR=0.64), professional driver (PR=0.95), and high levels of education (PR=0.68).

Discussion and conclusion: Age as a risk factor may be linked to licensure duration, as well as to the implementation of a new traffic law whereby driving after drinking is a crime. License restriction based on psychological issues as a risk factor reinforces the need for new assessments before license renewal. Protective factors corroborate previous findings. An inverse relation was observed between repeat offending and education level, suggesting that mass media

dissemination of the new law is not reaching the lowest education strata. As for professional drivers, the fear of losing a job may be an influence on driving behavior. Internationally reported rates of one-time and repeat DUI offenses are higher than here reported, probably as a result of the poor law enforcement in Brazil.

Introduction: For decades, studies have warned against the combination of drinking and driving, mainly because of the resulting increase in the risk of accidents, severe injuries, and mortality (Ahlm, 2009). Alcohol consumption impairs the abilities required for driving a vehicle: reflexes, perception of speed and obstacles, ability to control the vehicle, and visual acuity. Other effects include impaired judgment and more impulsive and aggressive behaviors (Kelly,2004). No Brazilian study so far attempted to describe the profile of repeat offenders convicted of drinking and driving

Method: We conducted a cross-sectional study with all drivers licensed in the state of Rio Grande do Sul (RS), southern Brazil. Data provided by the RS State Traffic Department for 3,949,693 licensed drivers were analyzed from January 2009 to December 2010 to identify DUI offenders. Drivers convicted of DUI more than once over a period of 24 months were considered recidivists.

Results: Of all the 3,949,693 drivers licensed in the state of Rio Grande do Sul, 12,204 (0.3%) had been convicted of DUI in the past two years (approximately 3 per 1,000 drivers). Of these, 11,666 (95.59%) had committed one violation, and 538 (4.41%) were recidivists. Our findings revealed that the main characteristics of DUI recidivists were being male, aged 41 to 50 years, licensed for over 12 years, having a low education level, and considered able to drive with psychological restrictions. The results of the psychological assessment with restrictions are applied when the driver has a psychological disorder, but it is temporarily under control. In this case, the driver is submitted to another psychological assessment after a determined period (from 1-5 years).(See Table 1)

Table 1-Sociodemographic characteristics of recidivist and non-recidivist in the state of Rio Grande do Sul

	Recidivist					
	Yes n=538		No n=11,666			
Years 2009-2010	N	%	N	%	PR	Adjusted PR**
Sex						
Male	529	98	11,360	97	1	
Female	9	2	306	3	0.64	
Age range (years)						
18 to 20	12	2	643	6	1	
21 to 30	111	21	3,769	32	1.56	
31 to 40	138	26	2,691	23	2.66	
41 to 50	177	33	2,657	23	3.41	
51 to 60	79	15	1,449	12	2.82	
≥ 61	21	4	457	4	2.40	
Mean age*	41	(11.2)	37	(12.5)		
Education level						
Elementary school	361	68	6,609	57	1	
High school	140	26	4,124	35	0.63	
Under graduate	33	6	899	8	0.68	
N/A	4		34			
License duration (years)						
≤ 2	70	13	2,196	19	1	1
3 to 5	49	9	1,681	14	0.92	0.96
6 to 8	55	10	1,328	11	1.29	1.33
9 to 12	58	11	1,446	12	1.25	1.28
> 12	306	57	5,015	43	1.86	1.81
Mean license duration	16	(10.7)	13	(10.9)		
Type of vehicle driven upon notification						
Car/utility	435	82	9,438	82	1	1
Motorcycle/motor scooter/moped	62	12	1,369	12	0.98	0.93
Pickup/van/truck/motor home/semitrailer/tractor	31	6	655	6	1.03	0.96
Bus/minibus	1	0.03	38	1.9	0.58	0.54
N/A	9		166			
Professional driver						
Yes	137	0.25	3,087	26	0.95	0.91
No	401	0.75	8,579	73	1	1
Psychological assessment***(N= 8,646)						
Able to drive	301	91	7,762	93	1	1
Able to drive with psychological restriction	29	9	554	7	1.33	1.23

Reference categories have prevalence ratio (PR) = 1
** Variables represented by the mean (SD)
* PR adjusted for age, sex and education
***Missing data

PR values for license category ranged from 0.76 for E category (trucks weighing ≥ 6,500 kg) to 1.36 for AC category (motorcycles and trucks between 3,500 and 6,000 kg) (reference category: B). A Category (motorcycles) showed a PR of 0.92, and C category (midsized trucks), of 1.14; individual categories showed lower PRs when compared with combined categories.

When comparing psychological assessment results and professional driver status among recidivist, both professional and non-professional drivers showed a similar distribution of psychological assessment outcomes (able or able with psychological restrictions). Among non-recidivist, the number of professional drivers considered able to drive with psychological restrictions was 8% higher than the number of drivers able to drive (See Figure 1).

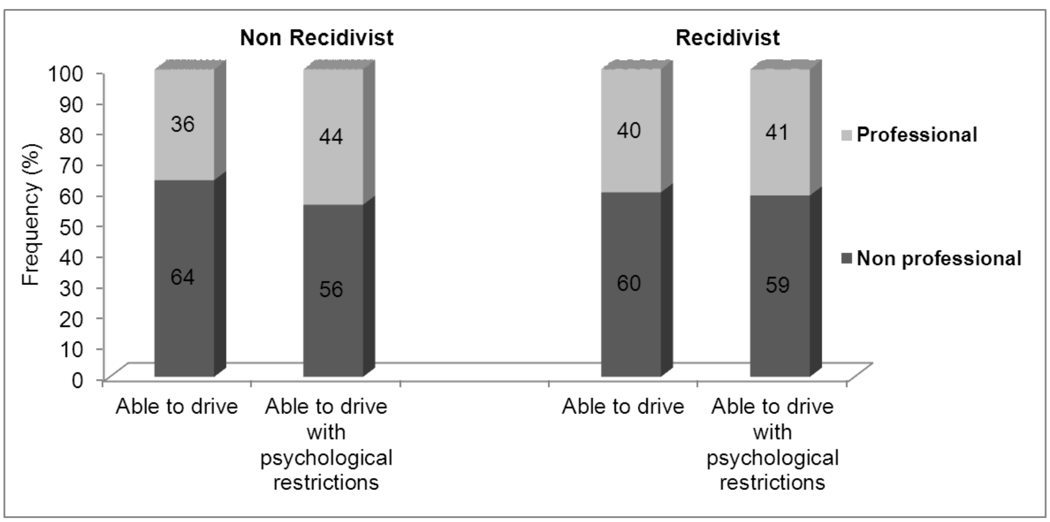

Figure 1 - Comparison between professional (n = 3,224) and non-professional (n = 8,978) drivers in relation to psychological assessment results among recividist (n = 330) and non-recidivist (n = 8,315).

Discussion

The predominance of males among both DUI recidivists (98%) and non-recidivists (97%) was nearly absolute. This high percentage of males may reflect alcohol consumption patterns among

Brazilian men, which exceed female consumption in quantity, frequency, and intensity, even when driving motor vehicles (Laranjeira, 2007). Our results indicate as the majority of DUI recidivists were aged between 41 and 50 years; one possible explanation for this could be the fact that drivers in this age group were trained in the old traffic regulation system, and that enrollment in courses or tests to adapt to the new system were not enough to prevent this type of behavior. Present study also found that drivers licensed for over 12 years were the most common recidivists, which reinforces the hypothesis raised earlier about drivers trained in the old traffic regulation system. Another possible assumption is that, as older age tends to be related to higher family income and financial independence, the application of fines may not have the necessary impact to prevent drinking and driving behaviors in this population. Another hypothesis would be at a greater risk for being diagnosed with alcohol dependence disorder, leading to an increased consumption, the need to use it, and loss of control, regardless of the risks involved. In addition, older individuals come from a culture where drinking and driving was socially accepted, and could have a greater resistance to accept changes in the current legislation. The recurrence rate of DUI violations found in our study was lower than the rates reported in other international studies, probably as a result of a poor enforcement of traffic laws in Brazil. Educational data collected for our DUI offenders were similar to those reported in international study, suggesting an association between low education levels and drinking and driving behavior (Impinen, 2011). Related to license categories, our data indicate that categories A, E, and AE were protective factors. This can be partially explained by the perceived potential risk associated with these vehicle types, namely motorcycles show a higher risk for motorcyclist injuries, whereas heavy vehicles are generally involved in large accidents (Chuc,2012). Regarding the type of vehicle being driven at the time of notification, buses and minibuses were considered a protective factor in relation to other vehicles approached. This may be explained by the higher probability of being monitored by employers and the impact of penalties on the driver's life. In our sample, most DUI recidivists were considered able to drive with psychological restrictions. These data suggest an important role of psychological assessments to detect the presence of psychological problems potentially related to drinking and driving, and underscore the need to investigate such assessments in more detail. This is also the case with non-recidivist. In Brazil, when candidates are considered able to drive in obtaining their first license, it is likely that they will never undergo a new psychological assessment, because reassessment is mandatory only for professional drivers (every 5 years). This allows non professional conductors to drive without a periodic monitoring by expert psychologists.

Conclusions

Our findings revealed that the main characteristics of DUI recidivists. These new data on the profile of DUI offenders can help determine changes in strategic campaigns aimed at the prevention, education, and rehabilitation of drivers, representing an important epidemiological tool to assist in reducing drinking and driving in Brazil. Moreover, public policies can be developed with specific behavioral strategies for these drivers.

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“I drove after drinking alcohol” and other risky driving behaviours reported by young novice drivers

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Abstract

Background
Volitional risky driving behaviours including drink- and drug-driving and speeding contribute to the overrepresentation of young novice drivers in road crash fatalities, and crash risk is greatest during the first year of independent driving in particular.

Aims
To compare: 1) the self-reported compliance of drivers with road rules relating to substance-impaired driving and other risky driving behaviours including speeding and driving tired, one year after progression from a Learner to a Provisional (intermediate) licence; and 2) the interrelationships between substance-impaired driving and other risky driving behaviours (crashes, offences, and Police avoidance).

Methods
1268 drivers (373 males) aged 17-26 years were surveyed regarding their sociodemographics (age, gender) and self-reported driving behaviours including crashes, offences, Police-avoidance, and driving intentions.

Results
A relatively small proportion of participants reported driving after taking drugs (5.9% males, 1.3% females) and drinking alcohol (19.3% males, 11.6% females). In comparison, a considerable proportion of participants reported at least occasionally exceeding speed limits (85.7% novices) and driving when tired (82.7% novices). Substance-impaired driving was associated with avoiding Police, speeding, risky driving intentions, and self reported crashes and offences. Forty-four percent of illicit-drug drivers also reported alcohol-impaired driving.

Discussion and conclusions
The low self-reported prevalence of substance-impaired driving suggests official enforcement measures play a role in promoting compliance, in addition to social influences such as the broader community and the young novice drivers’ social networks including friends and family. Conversely, the prevalence of speeding appears to reflect the pervasive cultural acceptance of this behaviour. Given the interrelationships between the risky driving behaviours, a deeper understanding of influential factors is required to inform targeted and general countermeasure implementation and evaluation during this critical driving period.

Introduction

Young novice drivers – drivers aged 17-25 years who hold an intermediate (Provisional) driver’s licence and therefore are inexperienced drivers– constitute a major public health concern due to their numbers of crashes, their rates of crash involvement, and the injuries and fatalities arising from those crashes. The overrepresentation of young drivers in road crashes is a persistent global road safety problem (European Transport Safety Council, 2011). In Australia in 2011, 17-25 year olds comprised 12.9% of the nation's population, but contributed 21.9% of the road crash fatalities (BITRE, 2012). Substance-impaired driving – driving after drinking alcohol or taking illicit drugs such as marijuana or ecstasy –is problematic for drivers of all ages and experience. Age and alcohol appear to have an interactive effect, increasing relative crash risk for the young driver (Peck et al., 2008). The likelihood of driving after drinking increases five-fold for the driver who drinks alcohol in conjunction with illegal drugs and the young drink driver is also significantly less likely to wear a seatbelt (Everett et al., 1999). Illicit drugs (e.g., marijuana) have been found to negatively impact on driving abilities by reducing alertness and concentration whilst increasing reaction times (Donald et al., 2006). A Danish study reported a 25 times greater risk of harm when driving after using illicit drugs either alone or in combination, increasing to 35 times greater if the driver also consumed alcohol (Twisk & Stacey, 2007).

Whilst substance-impaired driving is problematic for young, inexperienced drivers, other risky driving behaviours such as speeding, carrying passengers, and driving tired are also of concern. Young drivers who crashed whilst under the influence of alcohol in the United States between 2005 and 2009 were more likely to be males who were speeding, not wearing a seatbelt, and carrying passengers on a weekend night (Williams et al., 2011). Substance-impairment may reduce wearing of seatbelts and increase the number of passengers carried; young drivers occasionally are found to carry more passengers within the cabin of passenger vehicles than there are seats (and therefore seatbelts) (e.g., see Calligeros, 2009). Young drivers also drive at times which are in conflict with circadian rhythms and which may also involve alcohol and carrying peers who may be a negative influence upon their behaviour (Papadakaki et al., 2008). Further, regular mobile phone users report frequent speeding, crashes and driving violations (Schlehofer et al., 2010). Punishment avoidance (active attempts at avoiding punishment such as a traffic citation), or inadvertently receiving rewards (such as social status or a faster journey) for risky driving behaviours such as speeding appears to increase the likelihood that the risky behaviour will be repeated. As such, substance-impaired young novice drivers may actively engage in punishment-avoidant behaviour to evade detection and apprehension by Police. This paper summarises the self-reported risky driving behaviours of young drivers within the realms of substance-impaired driving, speeding, driving errors, general risky driving, and carrying passengers in risky circumstances, one year after progression from a Learner to a Provisional (intermediate) licence. The interrelationships between substance-impaired driving and other risky driving behaviours, crashes, offences, Police avoidance, and driving intentions will also be examined.

Method

Participants
Drivers (n = 1268, 373 males) aged 17-26 years (M =19.09, SD = 2.11) completed a paper survey one year after obtaining their Queensland Provisional 1 (P1) driver's licence.

Design, Procedure, Materials and Statistical Analysis
Queensland drivers who progressed from a Learner to a Provisional licence in the period April through June 2010 received a survey from the state government licensing authority (Department of Transport and Main Roads) on behalf of the research team one year after obtaining their licence later. Of the 9393 drivers aged 17 years and older who were eligible to

participate, 1268 surveys were returned by drivers aged 17-26 years. Survey items included gender and age; punishment avoidance through paying attention to, and avoiding, Police (*no, yes*); future driving intentions to bend (1 *definitely will not*, 7 *definitely will*), and likelihood of bending (1 *very unlikely*, 7 *very likely*), road rules; and self-reported crash involvement and offence detection (*no, yes*). The 44-item Behaviour of Young Novice Drivers Scale (BYNDS) (Scott-Parker et al., 2010) assessed self-reported risky driving behaviour (1 *never*, 5 *nearly all the time*), including driving after drinking alcohol ('drink driving') and driving after taking illicit drugs such as marijuana and ecstasy ('drug driving'). Analysis of variance and Pearson chi-square were used to compare means, evaluated at significance $\alpha = .05$.

Results

As shown in Table 1 nearly 16% of participants reported drink driving and3% reported drug driving. One fifth reported being involved in between one and three crashes during the first year of their P1 licence; 84.8% reported one crash only. One quarter reported being detected for between one and six offences; 72.7% reported one offence only. Males reported more risky and illegal driving behaviours including substance-impaired driving; more punishment avoidance behaviour; and stronger intentions to drive riskily in the future (Table 1). A significantly greater proportion of males reported that they had been detected for an offence; male participants reported between one and six offences, and female participants reported between one and five offences (66.9% and 76.5% respectively one offence only, $p < .001$).

Table 1: Proportion of young drivers reporting at least occasionally performing behaviour, crash-involvement and offence-detection, and future driving, by gender.

Risky driving behaviours, future driving intentions, crashes and offences	Proportion (%) of drivers Total *N*=1268	Males *N* = 373	Females *N* = 895
Substance-impaired driving [1]			
When thought over legal alcohol limit	15.9	**19.3**	**11.6 *****
After taking illicit drugs	2.7	**5.9**	**1.3 *****
Speeding [1]			
Up to 10 km/hr over speed limit	85.7	**76.9**	**85.3 ****
Went 10-20 km/hr over speed limit	50.6	**58.4**	**47.3 *****
More than 20 km/hr over speed limit	31.2	**41.0**	**27.2 ****
Over speed limit if detection unlikely	64.0	**67.5**	**62.6 ****
Sped up when lights went yellow	77.7	75.3	78.7
Deliberately sped when overtaking	69.2	**75.7**	**66.5 *****
Raced out of intersection on green light	50.3	**58.6**	**46.8 ****
Sped at night on poorly-lit roads	23.5	**32.7**	**19.7 *****
Too fast around a corner	48.1	47.0	48.5
Novice driving errors [1]			
Misjudged speed exiting main road	35.4	40.5	37.5
Misjudged stopping distance needed	46.3	**38.3**	**49.7 ***
Misjudged gap overtaking	20.9	18.8	21.7
Misjudged gap turning right	19.4	16.1	20.8
Misjudged speed oncoming vehicle	33.5	**26.9**	**36.3 ***
Turned right into path of vehicle	14.0	15.5	13.4
General risky driving [1]			
Spoke on handheld mobile	38.4	41.8	36.9
Drove through red light if no camera	5.1	**8.6**	**3.7 *****
Didn't always wear seatbelt	5.7	**7.8**	**4.8 ***
Didn't wear seatbelt for short trip	7.8	**10.2**	**6.0 ****
Drove when knew were tired	82.7	81.5	83.2
Drove faster if in bad mood	58.1	58.7	57.8
Driving affected by emotions	63.5	61.7	64.3

Carrying passengers in risky circumstances [1]			
Exceeded night passenger limits [2]	48.5	51.3	47.3
Passengers didn't wear seatbelts	4.9	6.2	4.4
Carried more passengers than seatbelts	3.2	**5.4**	**2.2 ***
Carried more passengers than legally fit	3.2	**5.6**	**2.1 ****
Car full of friends as passengers	69.0	70.4	68.4
Carried friends as passengers at night	77.5	79.1	76.8
Punishment avoidance			
Pay attention to Police presence	91.0	88.9	91.9
Avoid Police presence	15.2	**23.3**	**11.9***
Driving outcomes			
Crash-involved	22.2	19.5	23.3
Offence-detected	26.5	**34.6**	**23.1 ****
Future driving			
Intentions	8.9	**12.9**	**7.1 *****
Likelihood	22.9	**28.9**	**20.4 *****

[1]Items from the Behaviour of Young Novice Drivers Scale (BYNDS; Scott-Parker et al., 2010) except for '*Exceeded night passenger limits'*.[2] GDL night passenger limit restriction (≤ 1 peer passenger 11pm-5am).
* p< .05, **p< .01, ***p< .001. Significant gender differences are bolded for ease of reference.

Drinking drivers reported more drug driving, speeding, driving errors, general risky driving behaviour, carrying passengers in risky circumstances, and reported stronger intentions to drive riskily in the future (Table 2). Thirty-two percent of drinking drivers avoided on-road Police presence, compared to 12.6% of non-drinking drivers (p< .001). Participants who reported drug driving also reported significantly more drink driving, speeding, novice driving errors, general risky driving behaviour, and carrying passengers in risky circumstances. Drug drivers also reported stronger risky driving intentions (Table 2), whilst 35% of drug drivers reported avoiding on-road Police presence, compared to 14.7% of non-drug drivers (p < .01).

Table 2: Means (and standard deviations) for the risky driving behaviours, future driving intentions, and number of crash-involvements and offences-detected.

Risky driving behaviours, future driving intentions crash-involvement and offences	Drink-Drive *M* (*SD*) No *N* = 1091	Drink-Drive *M* (*SD*) Yes *N* = 176	Drug-Drive *M* (*SD*) No *N* =1234	Drug-Drive *M* (*SD*) Yes *N* = 34
Substance-impaired driving [1]				
When thought over legal alcohol limit	___	___	**1.15 (.40)**	**1.79 (1.15)*****
After taking illicit drugs	**1.04 (.32)**	**1.14 (.51)****	___	___
Speeding[1]				
Up to 10 km/hr over speed limit	**2.47 (.98)**	**2.95 (.99)*****	2.53 (.99)	2.85 (1.08)
Went 10-20 km/hr over speed limit	**1.62 (.82)**	**2.18 (1.01)*****	**1.68 (.82)**	**2.12 (1.07)****
More than 20 km/hr over speed limit	**1.36 (.65)**	**1.81 (.90)*****	**1.41 (.69)**	**1.76 (1.05)****
Over speed limit if detection unlikely	**1.93 (.95)**	**2.62 (1.13)*****	**2.01 (1.00)**	**2.53 (1.21)****
Sped up when lights went yellow	**2.18 (.95)**	**2.75 (1.06)*****	2.25 (.99)	2.38 (1.02)
Deliberately sped when overtaking	**2.06 (1.05)**	**2.82 (1.18)*****	**2.16 (1.09)**	**2.59 (1.33)***
Raced out of intersection on green light	**1.70 (.93)**	**2.34 (1.13)*****	1.78 (.99)	1.97 (.97)
Sped at night on poorly-lit roads	**1.25 (.56)**	**1.79 (1.08)*****	**1.30 (.66)**	**2.15 (.93)*****
Too fast around a corner	**1.54 (.68)**	**1.86 (.76)*****	1.59 (.70)	1.53 (.71)
Novice driving [1]				
Misjudged speed exiting main road	**1.39 (.59)**	**1.60 (.85)*****	**1.41 (.61)**	**1.79 (1.23)*****
Misjudged stopping distance needed	**1.53 (.66)**	**1.71 (.69)****	1.55 (.66)	1.65 (.88)
Misjudged gap overtaking	**1.19 (.44)**	**1.54 (.75)*****	**1.23 (.49)**	**1.62 (1.02)*****
Misjudged gap turning right	**1.20 (.46)**	**1.33 (.62)****	**1.21 (.46)**	**1.62 (1.02)*****
Misjudged speed oncoming vehicle	**1.36 (.56)**	**1.54 (.74)*****	1.38 (.58)	1.56 (.89)
Turned right into path of vehicle	**1.14 (.38)**	**1.27 (.52)*****	**1.15 (.39)**	**1.50 (.71)*****
General risky driving [1]				
Spoke on handheld mobile	**1.47 (.75)**	**1.97 (.96)*****	1.54 (.80)	1.56 (.71)
Drove through red light if no camera	**1.05 (.26)**	**1.18 (.55)*****	**1.05 (.27)**	**1.56 (.99)*****
Didn't always wear seatbelt	**1.05 (.31)**	**1.23 (.63)*****	**1.07 (.33)**	**1.47 (1.08)*****

Didn't wear seatbelt for short trip	**1.07 (.35)**	**1.34 (.77)*****	**1.10 (.41)**	**1.44 (1.08)*****
Drove when knew were tired	**2.32 (.95)**	**2.95 (.98)*****	2.41 (.98)	2.68 (1.09)
Drove faster if in bad mood	**1.78 (.89)**	**2.45 (1.14)*****	1.87 (.96)	2.18 (.94)
Driving affected by emotions	**1.88 (.91)**	**2.51 (1.08)*****	**1.95 (.95)**	**2.59 (1.23)*****
Carrying passengers in risky circumstances [1]				
Exceeded night passenger limits [2]	**1.72 (.95)**	**2.09 (1.13)*****	**1.76 (.97)**	**2.32 (1.27)****
Passengers didn't wear seatbelts	**1.06 (.32)**	**1.14 (.49)****	**1.06 (.34)**	**1.32 (.64)*****
Carried more passengers than seatbelts	**1.03 (1.66)**	**1.14 (1.78)*****	**1.03 (.22)**	**1.41 (.82)*****
Carried more passengers than legally fit	**1.03 (.21)**	**1.10 (.41)****	**1.03 (.21)**	**1.26 (.79)*****
Car full of friends as passengers	**2.22 (1.11)**	**2.57 (1.14)*****	2.27 (1.12)	2.18 (1.24)
Carried friends as passengers at night	2.31 (1.05)	2.65 (1.04)	**2.34 (1.05)**	**2.85 (1.11)****
Driving outcomes				
Number of crashes	1.16 (.41)	1.21 (.41)	1.16 (.41)	1.40 (.52)
Number of offences	1.34 (.70)	1.53 (.87)	**1.35 (.68)**	**1.93 (1.44)****
Future driving				
Intentions	**2.15 (1.37)**	**3.25 (1.57)** ***	**2.28 (1.44)**	**3.09 (1.73)****
Likelihood	**2.90 (1.66)**	**4.14 (1.78)*****	3.07 (1.72)	3.09 (2.28)

In addition to footnotes of Table 1, ___ = not applicable.

Discussion

The self-reported prevalence of drink driving amongst young drivers with only one year's independent driving experience was nearly 16%, which is approximately half of the one third of drivers generally who report drink driving in Queensland (Watson & Freeman, 2007), suggesting broad general enforcement using random breath testing (RBT) should continue. Similarly, the noteworthy proportion of young drivers who use drugs and also drive after drinking suggests that current RBT efforts augmented by roadside saliva-based drug testing should continue. The desirability of transportation alternatives in particular also need to be considered in intervention development, particularly as young drivers report desirability of alternative transportation is more important than its availability (Nygaard et al., 2003). The alarming proportion of young drivers who report driving in excess of speed limits, and the rates of speeding reported by substance-impaired drivers in particular, suggests that increased enforcement of speed limits is required generally. Other technology such as speed limiting devices (e.g., Lahrmann et al., 2012) may also prove beneficial in young driver road safety.

The breadth of driving errors reported by participants, effectively *two years* after they began driving suggests the need for a more structured approach to the Learner period. Almost half the participants reported violating Queensland's graduated driver licensing night-time passenger restrictions, with those reporting substance-impaired driving reporting more frequent passenger limit violations. Interestingly, many young drivers reported driving even though tired, suggesting they may be unaware of impending sleep associated with such fatigue, or that driving to and arriving at their destination as planned is more important than resting when fatigued. Targeted interventions highlighting the risks associated with driving tired, incorporating suggestions for journey planning including transportation alternatives and effective time management practices, are required. Three in five adolescents reported driving in response to their moods, and specifically to driving faster if they were in a bad mood. Rather than an efficient and economical method of getting from the point of departure to the destination, young drivers report driving serves a multitude of purposes, including being an outlet for emotional outbursts and resolving emotional distress (e.g., Redshaw, 2006). Targeted interventions which similarly highlight the riskiness of this driving purpose, in addition to alternatives to resolve emotional distress, warrant further investigation.

Conclusion

Young drivers are at considerable risk on the road, and the first year of independent driving is the most risky time for all young novice drivers. Substance-impaired driving, speeding, novice driving errors, general risky driving, carrying passengers in risky circumstances, punishment avoidance, and risky anticipated driving behaviours have been found to increase the crash risks for young novice drivers, placing themselves, their passengers, and other road users at greater risk of injury and death. Substance-impaired young drivers report the most risky current and anticipated driving behaviour, suggesting that targeted countermeasures such as random breath and saliva testing require ongoing enhancement. In addition, interventions targeting the tired young driver and the speeding young driver are warranted, as are efforts to reduce the benefits of, and opportunities for, active punishment avoidance.

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Acceptance of rehabilitation with alcohol interlock support for DUI offenders in Germany

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Background

In Germany an IID project is being prepared by different companies, amongst others DEKRA and AFN.
The projected interlock program does not only include the installation of a device, but a number of other engineering, medical, toxicological and psychological activities that prevent drunk driving. Using a long-term experimental study, the use of IIDs is explored. Rehabilitation has a long tradition in Germany. Additional psychological rehabilitation programs result in lasting behavioral changes. The following experimental groups will be included in this IID project:

- Individual psychological intervention (according to Alfred Adler) (AFN)
- Behavioral psychological intervention (DEKRA)
- Inpatient detoxification (addiction treatment)
- No rehabilitation program / psychological intervention, all of those combined with an IID.

Some implementation issues are as yet unsolved:

- No legal foundation for an offender program
- Would the project be part of the criminal or the administrative law?
- A driver without the required fitness to drive is not allowed to drive until the driver´s fitness is retrieved
- No "limited fitness / qualification" by using an Alcohol-Interlock.

Aims

In preparation for the long-term experimental study, a small investigation about the acceptance of alcohol interlocks in Germany was performed. This paper focuses only on the cost-benefit aspects from the view of the offenders.

Methods

These aspects of the current study in preparation of the major one have been captured with the help of a questionnaire from a sample of 607 subjects, who participated in a rehabilitation course after (at least) one DUI offence.
The subjects were asked about various topics.

Results

On the question of acceptance of participation in a course and accepting installation of an alcohol interlock device the almost 80 % of the subjects would want to participate in the alcohol interlock project.

Table 1: Potential participation in the alcohol interlock project without cost analysis (in %)

I would …	1	definitely take part	51
	2	certainly take part	27
	3	- I don´t know	18
	4	not take part	3
	5	definitely not take part	1

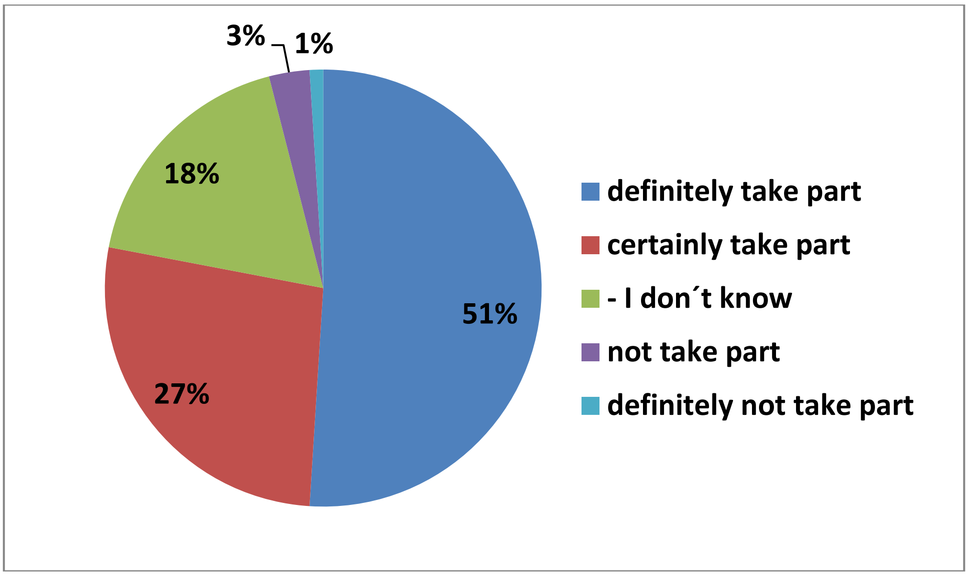

Fig. 1: Potential participation in the alcohol interlock project without cost analysis (in %)

After having been informed about the costs (monthly expenses of about 100 EUR):

Table 2: Potential participation in the alcohol interlock project with cost analysis (in %)

				low-income earners
I would …	1	definitely take part	28	30
	2	certainly take part	22	17
	3	- I don´t know	29	30
	4	not take part	14	15
	5	definitely not take part	7	8

In the last column "low-income earners”, defined as the quarter of the participants with the lowest income. Even in this group, a high level of acceptance is expected. Marques (2001, p. 18) had also found that the costs usually are no general obstacle.

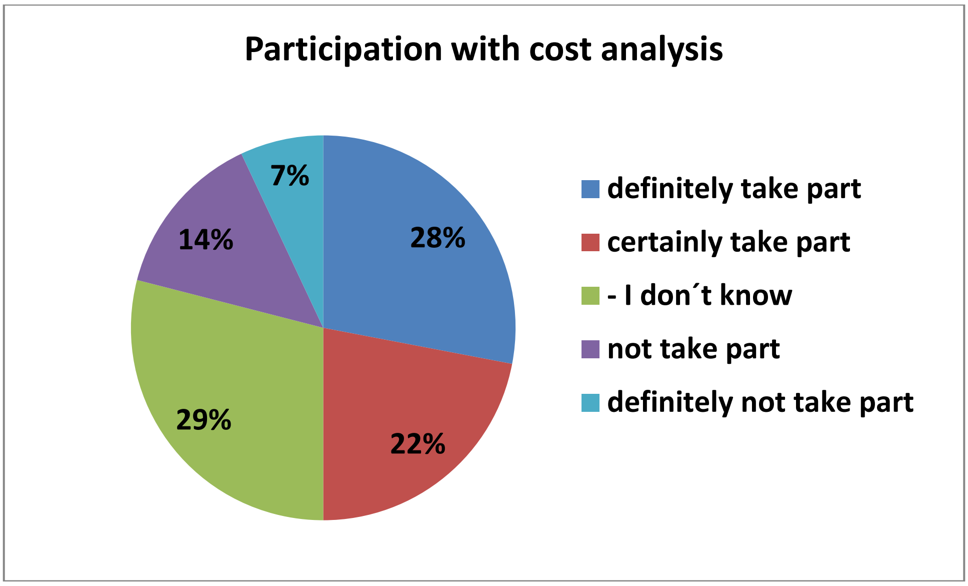

Fig. 2: Potential participation in the alcohol interlock project with cost analysis (in %)

Even after inclusion of their own costs for the installation of alcohol interlock device, half of the clients are ready to attend. Another quarter is undecided. If this group could be motivated to participate, the number of potential participants would rise to about 75 % of the respondents.

In Table 3 the results are shown, how many respondents would expect a benefit from an earlier relicensing, and to what extent. 23 % of the group would expect a much higher income if they could work in their former jobs, which would not be possible without a license.

Table 3: monetary benefit through earlier new license

	Percentage	average monthly benefit
higher income	23 %	797 EUR
decreasing travel costs	41 %	185 EUR
additional income	30 %	327 EUR

Many clients also report time savings when they would get their license reinstalled.

Table 4: temporal benefits through earlier license renewal

	Percentage	average daily time saving
time savings	76 %	1,9 h

Further non-monetary benefits often reported by participants of the investigation:

- family, shopping, doctor, parents, grandparents
- mobility, flexibility (private and professional life)
- independence.

Conclusions

Just below 80 % of the subjects declared that they would participate in the alcohol interlock project. Further 18 % were still undecided.

After knowing the costs, half of the interviewees said they would participate; still more one quarter was undecided. 21 % declined. Even from the group of low-income earners, half declared to be willing to participate in the project.
23 % indicated to be able to achieve a higher income.
76 % of the subjects indicated time savings due to the participation in the alcohol interlock project, i.e. nearly two hours daily on average.

It can be expected that, with the establishment of the regulatory administrative framework that a substantial part of the alcohol-influenced drivers would decide to participate in an alcohol interlock program.
However, a qualified incentive and briefing should be conducted.

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A comparison of medicinal drugs detected in blood of suspected impaired drivers with data on the use of driving impairing medicines in The Netherlands

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Abstract
This study presents the analytical results of blood samples of suspected impaired drivers during a four year period and compares the medicinal drugs detected in the blood samples with the use of these driving impairing medicines in The Netherlands. In 2009-2012, the blood alcohol concentrations of 9047 samples have been determined and 82% of the samples tested positive. In addition, 3038 blood samples have been analyzed for drugs and in 94% of the cases drugs were detected. Medicinal drugs were detected in 33% (1010/3038) of the drug cases, including poly-medicinal drug use in 37% (370/1010) of the positive medicinal drug cases. Anxiolytics have the highest prevalence of 19% (573/3038) in the population of suspected impaired drivers. Followed by hypnotics and sedatives (13%), medicinal opiates (6.9%), antidepressants (4.5%) and antiepileptics (1.1%). The prevalences of these medicinal drug groups in the general Dutch population are about two or three times lower for anxiolytics (6.9%), hypnotics and sedatives (5.5%), and antiepileptics (0.34%), compared to suspected impaired drivers. Medicinal opiates have about the same prevalence in both populations, which could be a result of the criteria used for the categorization of these substances. Antidepressants have a higher prevalence in the general Dutch population possibly due to differences in characteristics of the study populations (e.g. tolerance development and age). Overall, the results show that the prevalence of the selected medicinal drugs in suspected impaired drivers is higher than the prevalence of medicinal drugs in the general population. More research is needed to study the prevalence of all medicines that affect the driving performance.

Background
In the Netherlands, it is forbidden to drive under the influence of a substance of which a driver should be aware that it can negatively affect the driving performance, as stated in the Road Traffic Act [1]. This legislation includes alcohol, illicit and medicinal drugs. For alcohol, legal limits are 0.5 mg ethanol/ml blood and 0.2 mg/ml in novice drivers. For illicit drugs, there is a proposed law under consideration to adopt legal limits for nine frequently detected illicit drugs related to impairment. No legal limits are laid down for medicinal drugs. For information about side effects which could affect driving performance, drivers have to rely on medicine leaflets and information provided by pharmacists or physicians. Despite these warnings, there are still many road accidents due to impaired driving. In the year 2011, a total of 661 people were killed in road accidents in the Netherlands and an estimated 33 to 66 road fatalities are related to the use of medicinal drugs that affect the driving performance [2]. However, literature about the prevalence of medicinal drugs in suspected impaired drivers is limited.

Aims
Aim of this study is to present the analytical results of blood samples of drivers suspected of driving under the influence of alcohol, illicit drugs or medicinal drugs in The Netherlands and to compare the medicinal drugs detected in drivers with the medicinal drug use in the general Dutch population in order to get more insight in the role of medicinal drugs in road safety.

Methods
Generally, the detection of driving under the influence of alcohol is performed by breath tests. The moment drivers are not able to complete the breath test or the police-officer observes suspicious behavior which could indicate drug use, blood samples are collected. The blood samples of these suspected impaired drivers are sent to the Netherlands Forensic Institute (NFI) for alcohol and/or drugs analysis.

Alcohol concentrations were determined using the enzymatic "alcohol dehydrogenase (ADH)" method. Drugs analysis was performed by using two analytical methods LC-MS/MS and GC-MS (Liquid chromatography-tandem mass spectrometry and Gas chromatography-mass spectrometry), which gives both a qualitative and quantitative determination of a standard list of drugs (both medicinal and illicit). Table 1 gives an overview of the standard measured medicinal drugs categorized corresponding to the Anatomical Therapeutic Chemical (ATC) Classification System [3]. The illicit drug groups amphetamines, cocaine, cannabinoids, illicit opiates and GHB (*gamma*-Hydroxybutyric acid) were also included in the analytical methods. Additional targeted drugs analysis was performed on special requests or when there was a specific suspicion.

The medicinal drugs detected were compared with data on the users of these medicines among the general Dutch population, including all ages. The prescription-based data on the users of medicinal drugs covering 95% of the public pharmacists in the Netherlands was provided by the Dutch Foundation for Pharmaceutical Statistics (Stichting Farmaceutische Kengetallen, SFK) [4]. SFK provided data on the number of users of driving impairing medicines of category II and III (categorized by DRUID, Driving under the influence of Drugs, Alcohol and Medicines) during the years 2009-2012 [5]. In this study, only the standard list of medicinal drugs for DUID analyses is used for comparison of prevalence data.

The detection of metabolites is incorporated into the drugs prevalence. For instance, the metabolite demoxepam relates exclusively to chlordiazepoxide. In other cases, the categorization of metabolites is more complicated. Both temazepam (T) and oxazepam (O) can be metabolites of diazepam (D), but are also prescription drugs. In these cases concentrations were evaluated for categorization.

- Only T or O detected, indicates intake of T or O
- Concentration T or O higher than D, indicates intake of T or O
- Concentration T or O lower than D, indicates intake of D

For morphine (M) and codeine (C) other criteria, introduced by DRUID, were used to categorize these substances in either the illicit or medicinal opiates group. Since both morphine and codeine can also be metabolites of heroin [6].

- Only M or C detected, is categorized as medicinal opiates
- Both M and C detected and concentration M is lower than C, is categorized as medicinal opiates

- Both M and C detected and concentration M is higher or equal to C, is categorized as illicit opiates
- All combinations of M and/or C with heroin metabolite 6-monoacetylmorphine (6-MAM), are categorized as illicit opiates

Table 1: The standard list of medicinal drugs cat II and III in cases of driving under the influence

ATC pharmacological subgroup name: Medicinal drug (category)
Antiepileptics (N03A): clonazepam(II)
Anxiolytics (N05B): alprazolam(III), bromazepam(III), chlordiazepoxide(III), clobazam(II), diazepam(III), lorazepam(III), oxazepam(III)
Hypnotics and sedatives (N05C): brotizolam(III), flunitrazepam(III), flurazepam(III), lormetazepam(III), midazolam(III), nitrazepam(III), temazepam(III), zolpidem(II), zolpiclon(III)
Antidepressants (N06A): amitriptyline(III), nortriptyline(II)
Medicinal opiates (N02A): codeine(II), methadone(II), morphine(III), tramadol(III)

Results
During a four year period (2009-2012), the blood alcohol concentrations of 9047 samples have been determined. Figure 1 shows the number of cases versus the blood alcohol concentration in mg alcohol per ml of blood. Positive results were obtained in 82% (7432/9047) of the cases, of which the majority (7202/9047) had concentrations higher than 0.2 mg/ml of blood and 65% (5855/9047) had concentrations higher than 0.8 mg/ml of blood. The median alcohol concentration was 1.2 mg/ml of blood.

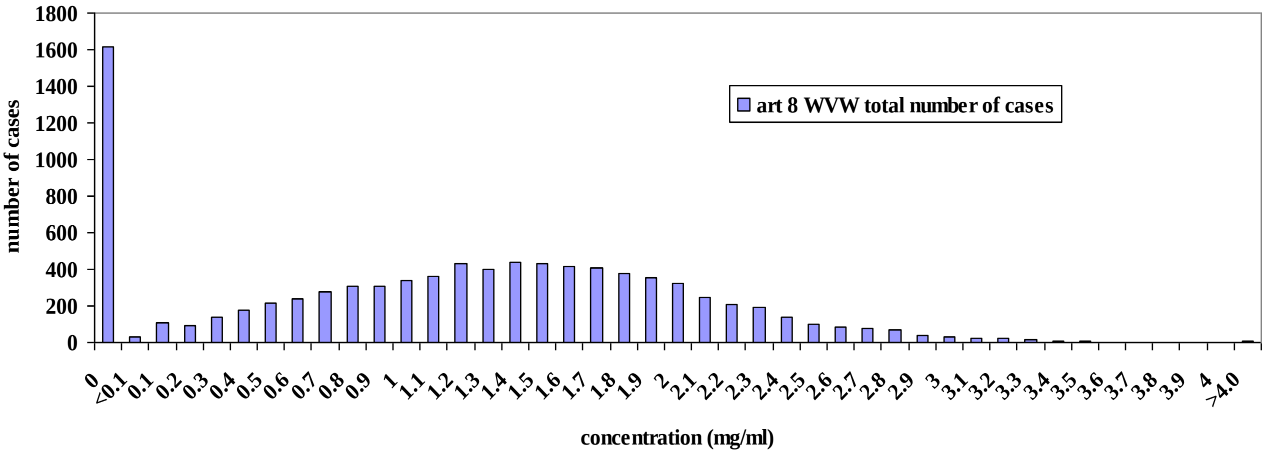

Figure 1: Blood alcohol concentrations (2009-2012). (n=9047)

In the same four year period, 3038 blood samples have been analyzed for drugs. In 94% of the cases drugs were detected. In 86% of the blood samples illicit drugs have been detected. Table 2 gives an overview of the prevalence of different illicit drug groups. The highest prevalence was found for cannabinoids, which were found in approximately half of the samples. In decreasing prevalence followed by amphetamines, cocaine, GHB and illicit opiates. The total percentage is greater than 100%, because in many cases poly-drug use is determined.

Table 2: The prevalence of illicit drugs in the analytical results. (n=3038)

Illicit drug group	*n*	*Prev. (%)*
Cannabinoids	1636	54
Amphetamines	1001	33
Cocaine	921	30
GHB	772	25
Illicit opiates	63	2.1

In addition, Figure 2 gives a global overview of the drugs analysis results, showing that 33% (1010/3038) of the samples tested positive for medicinal drugs affecting the driving performance. In 10% (306/3038) of the cases a combination of alcohol and drugs has been determined.

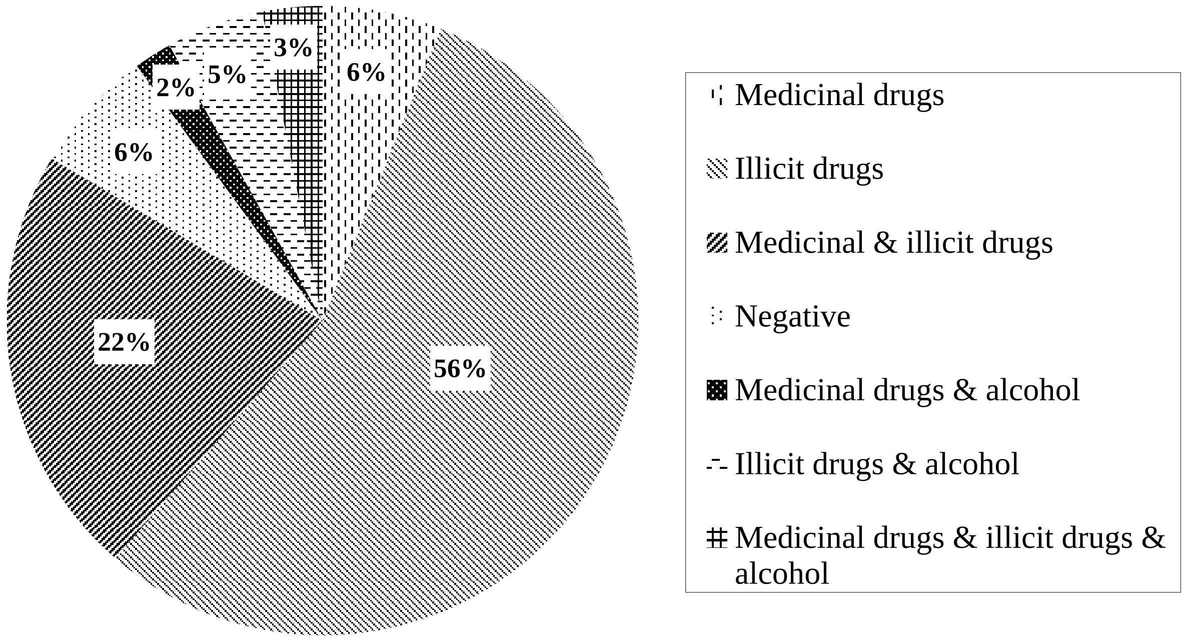

Figure 2: Results of the blood samples analyzed for drugs between 2009-2012. (n=3038)

The medicinal drugs are categorized according to the Anatomical Therapeutic Chemical (ATC) Classification System. Table 3 gives the prevalence of medicinal drugs in blood of suspected impaired drivers compared with the prevalence of medicinal drug use in the general Dutch population (SFK database). These results only include the substances which are standard tested in cases of driving under the influence (see Table 1). The total percentage in Table 3 is not equal to 100% because of the exclusion of the additional measured substances and because in many cases poly-drug use is detected. Anxiolytics have the highest prevalence (19%) in the blood samples, followed by hypnotics and sedatives (13%), medicinal opiates (6.9%), antiepileptics (1.1%) and antidepressants (0.89%).

The use of axiolytics (6.9%) is the highest in the general Dutch population, followed by medicinal opiates (6.8%), hynotics and sedatives (5.5%), antidepressants (1.4%) and antiepileptics (0.34%).

Table 3: The prevalence of "standard list of medicinal drugs" for analyzing blood of suspected impaired drivers (n=3038) and medicinal drug users in the general Dutch population (n=16.647.367)*

	Blood samples		*SFK database*	
Medicinal drug group	*n*	*Prev. (%)*	*n*	*Prev. (%)*
Antiepileptics (N03A)	34	1.1	56320	0.34
Anxiolytics (N05B*)*	573	19	1152275	6.9
Hypnotics and sedatives (N05C)	408	13	910170	5.5
Antidepressants (N06A)	27	0.89	233465	1.4
Medicinal opiates (N02A)	209	6.9	1130923	6.8

* The total population of The Netherlands, averaged between 2009-2012 [7].

Overall, the prevalence of selected medicinal drugs detected in the blood samples of suspected impaired drivers is higher than the prevalence in the general Dutch population, except for antidepressants. The prevalence of anxiolytics, hypnotics and sedatives, and antiepileptics are approximately three times lower in the general Dutch population than detected in the blood samples of suspected impaired drivers.

Figure 3 presents the number of combinations of different medicinal drug groups. In 37% (370/1010) of the positive medicinal drugs cases poly-medicine use was observed. Poly-medicine use of anxiolytics combined with hypnotics or sedatives has the highest prevalence of 7.8%. Another frequent combination of anxiolytics and medicinal opiates has a prevalence of 5.5%.

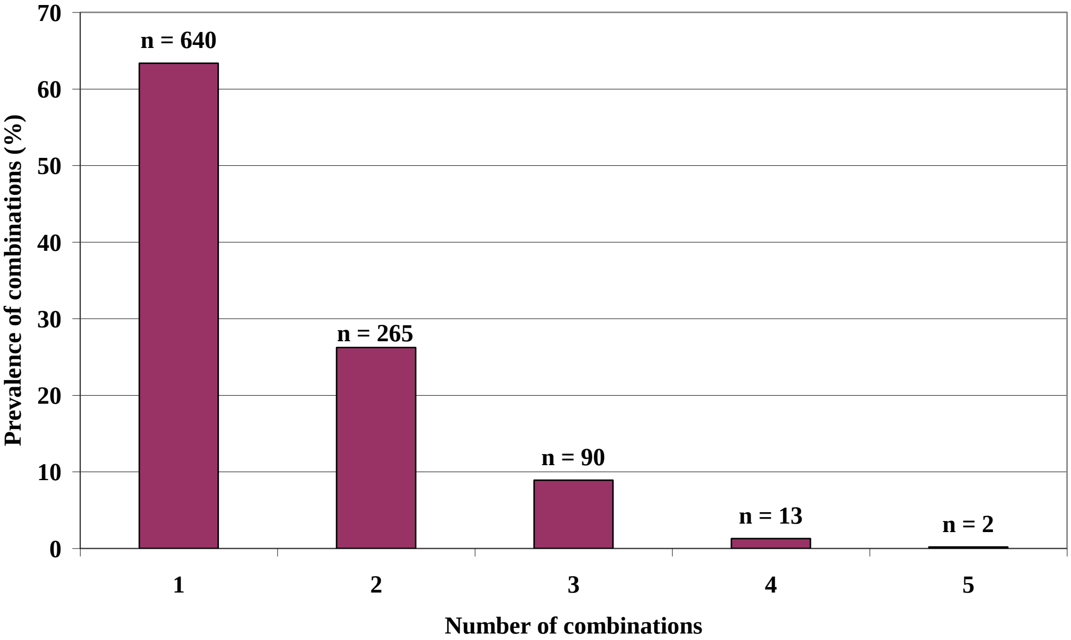

Figure 3: Poly-medicine use: combinations of different medicinal drug groups. (n=1010)

Discussion and conclusions

The results show that in 33% of the drug cases blood samples tested positive for medicinal drugs affecting the driving performance. In general, the prevalence of medicinal drugs in the blood samples is higher than the prevalence in the general Dutch population. This difference is due to the fact that blood samples are only collected from suspected impaired drivers, thereby creating a positively biased sample population. The prevalences of the medicinal drug groups anxiolytics, hypnotics and sedatives, and antiepileptics are about 3 times higher in the blood samples than in the general Dutch population, but maintain approximately the same ratio relative to each other.

The prevalence of antidepressants is higher in the general Dutch population compared to the prevalence in the blood samples. Differences between both populations in tolerance development and age could have contributed to this finding. Due to tolerance development driving impairing effects could become less noticeable to the police, leading to a lower prevalence in the population of suspected impaired drivers. In addition, the age distribution varies between both populations. The suspected impaired drivers population only includes people of sixteen years and older, while the data representing the general Dutch population includes all ages.

About the same prevalence is observed for medicinal opiates in both the general Dutch population and the suspected impaired drivers population. Categorization of morphine and codeine into either illicit or medicinal opiates drug use is difficult based on the toxicological results. Often, the analytical results cannot make a definite distinction, because the half-life time of the heroin metabolite 6-monoacetylmorphine is very short and can only be detected in blood up to a few hours. Therefore, additional criteria, introduced by DRUID (Driving under the influence of Drugs, Alcohol and Medicines), have been used and this could have lowered the prevalence of medicinal opiates in the suspected impaired drivers population.

In 37% of the positive medicinal drug cases poly-medicinal drug use is detected. In general, the prevalence of poly-medicinal drug use in the blood samples of impaired drivers may be underestimated. The same holds for the prevalence of combinations of alcohol and drugs. The first reason is that the moment a frequently used drug is detected there will be no further investigation into other drugs, except on special requests. The second reason is that in The Netherlands, blood samples containing alcohol concentrations higher than 0.8 mg/ml of blood are not screened for drugs, unless on special request of the public prosecutor. In this study, 5855 samples had a blood alcohol concentration over 0.8 mg/ml of blood of which some extend could have had an indication for drugs use. Finally, not all blood samples analyzed for drugs have also been tested for alcohol.

In conclusion, the results show that the medicinal drug positive drivers in this study population of suspected impaired drivers represent only a minor part of the users of the selected medicinal drugs affecting the driving performance in the general Dutch population. More research is needed to study the prevalence of all prescribed driving impairing medicines in the Dutch driving population and to investigate if providing additional information to medicinal drug users on driving impairing medicines would lower the number of medicinal drug positive drivers.

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Drink driving in Brazil: a question of law?

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Abstract

Background

In Brazil, after June of 2008, all drivers are subject to a "Zero Tolerance Law" and the alcohol limit is a breath alcohol concentration (BrAC) of 0.1 mg/L of air. However, there is an important loophole which allows drivers to refuse breath or blood alcohol testing as it may self-incriminate. The prevalence of drink driving is therefore a gross underestimate.

Aim

To compare the police reported prevalence of drink driving with self-reported alcohol consumption and driving behaviors gathered from questionnaires administered at police roadblocks in two Brazilian capital cities.

Methods

In the period August 2011 and January-February 2012 researchers administered a questionnaire on alcohol consumption and driver behavior to 800 voluntary participants during police conducted drink driving roadblocks, in Palmas and Teresina.

Results

In both cities, about 60% of drivers who self-reported having drunk within 6 hours of having been stopped by the police refused to perform breathalyzer testing or fled the roadblock or were not offered the test compared about 30% of drivers that said had not been drinking. The prevalence of BrAC positive, due to refusal and lack of data was of 9.8% and 5.7% in Palmas and Teresina, but in a simulation this prevalence can be as high as 25.1% and 22.8% respectively.

Discussion

Despite the reduction of the legal limit for drink driving, the legal uncertainty caused by the interpretation of the legislation, allows most drivers who drink and drive, though stopped by the police to return to the road with impunity. In this context he police/traffic officers are powerless to enforce the law and thus drink driving goes largely unchecked.

Introduction

Road traffic crashes victimize thousands of people every day and are a growing reality in large cities, especially in low- and middle-income countries (LMICs) in which more than 90% of road traffic deaths occur. Road traffic injuries (RTIs) result in high economic and social costs of around 1.0 to 1.5% of GDP in these countries, related to the spectrum of medical treatment, lost productivity, and intangible costs associated with the loss of lives (Peden et al., 2004; WHO 2009).

In 2010, approximately 42,000 people died as a result of crashes on Brazilian roads (Brazil, 2012). Of these deaths, as is the case in other LMICs, a high percentage was associated with alcohol. According to isolated studies from select state capitals, between 32.2 and 47% of fatal road traffic victims were under the influence of alcohol in any quantity at the time of the crash (Leyton et al 2005; Modelli, Pratesi e Tauil 2008; Stampe et al 2010).

Among interventions to reduce mortality caused by alcohol, the most effective are those that reduce the legal limit for drinking and driving, random breath testing in checkpoints, fast punishment when due, as a suspension of driving licence, treatment for recidivist drinking while intoxicated (DWI) offenders (Mann et al 2001; Henstridge et al. 1997; Borschos 2000; Wells-Parker et al 1995, Zobeck e Williams 1994).

In 1998, Brazilian law ("the New Traffic Code") provided a reduction in the legal blood alcohol concentration (BAC) legal limit to 0.06% (0.6 g of alcohol / L of blood) in addition to mandating seatbelt and helmet use, and establishing a penal system. Despite the decrease in traffic mortality rates, in the first years after its implementation (Fig. 1), was not possible to disagregate the results of the different 'established methods', due to a lack of monitoring and evaluation of the intervention (Brazil 1997).

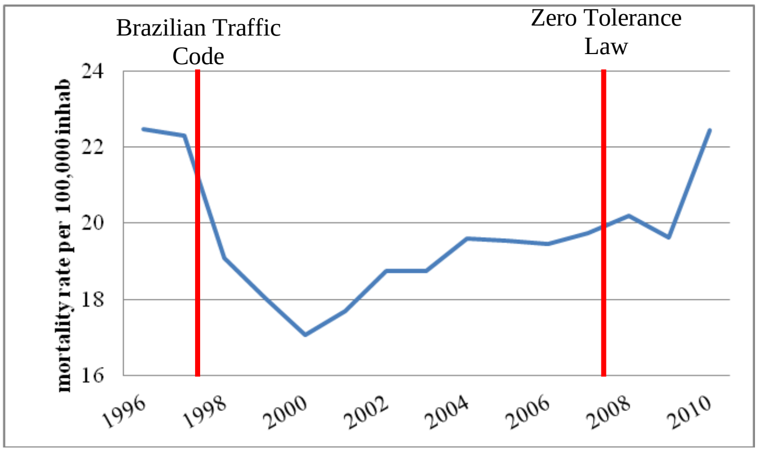

Fig. 1: Mortality rate per 100,000 inhab – Brazil – 1996-2010
Source: Brazil, Ministry of Health, 2012.
Note: deaths considering ICD-10: V01-V89.

After an initial decrease in the traffic mortality rates, the trend inverted, returning to the nearly the baseline measurement. In the 2008 a new "zero tolerance" law was approved reducing the alcohol limit by breath alcohol concentration (BrAC) to 0.1 mg/L of air, and more severe penalties (Brazil 2008).The first few months after the implementation of the "zero tolerance law" correspond with a

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decrease in traffic mortalities in 2009. However, there is an important loophole due to a controversial interpretation of an unrelated pact in which a driver can invoke the Pacto the São Jose (American Convention on Human Rights) can refuse to perform breathalyzer or blood testing so as not to create evidence against him or herself. Thus police or traffic officers are disempowered and cannot uniformly enforce existing legislation and likewise, the prevalence of reported drink driving is grossly underestimated.

In this light, the present study aims to compare the police reported prevalence of drink driving with self-reported alcohol consumption and driving behaviors gathered from questionnaires administered at police roadblocks in two Brazilian capital cities: Palmas, Tocantins and Teresina, Piaui during 2011 and 2012.

Methods

In the period August 2011 and January-February 2012 researchers from the Federal University of Rio Grande do Sul (UFRGS) in collaboration with the Johns Hopkins International Injury Research Unit (JH-IIRU) administered a questionnaire on alcohol consumption and driver behavior to 800 voluntary participants during police conducted drink driving roadblocks, in two state capitals, Palmas and Teresina. All sites for roadblocks were predetermined by police or traffic agents for their association with high numbers of crashes, with limited input from the research team. Drivers of cars and motorcycles were randomly selected from those persons stopped by the police. After obtaining informed consent, drivers were invited to participate in a structured interview. Once the interview concluded, the police or traffic officers continued with their standard procedures including performing the breathalyzer test. The results from this testing or the refusal to perform it, was incorporated into the interview later (Fig. 2).

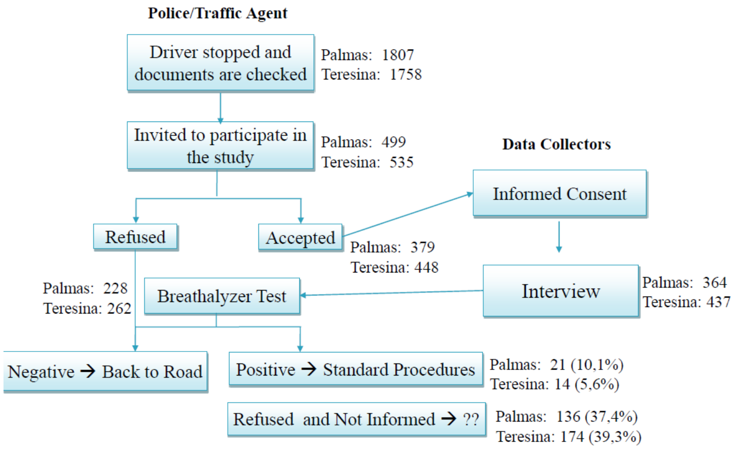

Fig. 2: Data Collection structure
Source: constructed by the authors

Data were collected from two rounds (August 2011 and January-February 2012) in two-hour roadblocks, on Wednesday through Saturday from 19hs and Sundays after 16hs. The traffic flow was counted considering the type of vehicle, which served to build the sample weight to reduce the bias in the type of vehicle.

To estimate the real prevalence of drink driving in this sample, we used information obtained from the interview – those who admitted to having drunk in the last 6 hours, weighted by the percentage of individuals who had but tested negative, plus the percentage of false information on alcohol consumption and breath test positive.

This study is part of the monitoring of Project Road Safety 10: Brazil – a Bloomberg Philanthropies Initiative in 10 LMICs.

Results

Table 1 shows select socio-demographic characteristics of the drivers interviewed in this study across the two rounds. In both cities most of the drivers are men, driving cars and more than 40% had finished at least high school. Regarding drink driving: about 60% self-reported having driven after drinking at least once a month in the last year; and about 10% self-reported having had a traffic crash while under the influence in their lifetime.

Table. 1: Drivers Socio-demographic Characteristics

Sample	***Palmas (n=364)***	***Teresina (n=436)***
Male	84.5% (80.8 - 88.2)	83.3% (79.8 - 86.8)
Age – mean*	31.22 (10.43)	36.04 (11.71)
Car	73.3% (68.8 - 77.8)	71.2% (66.9- 75.5)
Education - 12 years+	42.2% (37.1 - 47.3)	39.7% (35.1 - 44.3)
Drove after drinking -at least 1 X/month - last year	59.5% (54.5 - 64.5)	65.8% (61.4 - 70.3)
Has had a traffic crash caused by alcohol in their	10.5% (7.4 - 13.7)	9.0% (6.3 - 11.7)
Breathalyzer test (BrAC)>0	9.6% (6.6 - 12.6)	5.7% (3.5 - 7.9)
Reported alcohol consumption in last 6 hours	17.9% (14.0 - 21.8)	12.8% (9.7% -15.9)

Source: constructed by the authors
Note: between parentheses, 95% confidence interval for categorical variables and standard deviation for mean*

In both cities, about 60% of drivers that admitted to having drunk within 6 hours of having been stopped refused to perform breathalyzer testing or fled the roadblock without having been tested (68% in Palmas and 61% in Teresina) In Palmas 51% refused breathalyzer testing while in Teresina 41% of the drivers fled or were not offered the breathalyzer test by the police as compared to about 30% of drivers that said had not been drinking in that same city (Tab. 2).

Tab. 2: Comparison between questionnaire information and Breathalyzer test result

	Palmas			***Teresina***		
	Reported alcohol consumption in last 6 hours					
	Yes	No	Total	Yes	No	Total
BrAC>0	18%	3%	6%	11%	2%	3%
BrAC=0	14%	66%	57%	29%	61%	57%
Refused to perform the test, invoking the law	51%	15%	22%	20%	10%	11%
NI*	17%	15%	16%	41%	27%	29%

Source: constructed by the authors
Note: BrAC = Breath Alcohol Concentration; NI* indicates no information provided by the police about the performance of breathalyzer testing or the result: may indicate that the driver fled of the roadblock without performing the test, or it was not offered by the police.

Thus the prevalence of drink driving, in this case synonymous with positive BrAC, due to refusal and or the lack of data, was 9.8% and 5.7% in Palmas and Teresina respectively over the course of two rounds. However in in *simulation 2,* considering the refusal and the lack of information by the police, the prevalence can be as high as 25.1% and 22.8% respectively (Tab. 1 and Tab. 3).

Tab 3. Simulation for a Real Prevalence of drinking and driving

	Palmas	*Teresina*
BrAC>0 (1)	21	14
+ Reported alcohol consumption in last 6 hours & Refused test (2)	33	11
+ Reported alcohol consumption in last 6 hours & NI (3)	11	23
Simulation 1 (1+2+3)	**65 (17.9%)**	**48 (11.0%)**
BrAC>0+ No reported alcohol consumption in last 6 hours & Refused* (4)	14	19
BrAC>0+ No reported alcohol consumption in last 6 hours & NI * (5)	12	33
Simulation 2(1+2+3+4+5)	**91 (25.1%)**	**99 (22.8%)**

Source: constructed by the authors
Note: BrAC = Breath Alcohol Concentration

Discussion

Despite the reduction of the legal limit for drink driving, the legal uncertainty around the interpretation of the legislation, considering the Pacto of San Jose, permits drivers to engage in this risk factor for RTI without facing the consequences stipulated by law. Since drivers can refuse breathalyzer testing the police/traffic officers have little incentive to conduct roadblocks. Although some of the drivers under influence of alcohol invoke the Pact, others do not (i.e. escape the roadblock) and still avoid punishment thus explaining the low prevalence observed in both Palmas and Teresina. Estimations or simulations including persons who self-reported engaging in this behavior, particularly those who avoided being tested, are necessary to arrive at a truer prevalence.

Larger issues remain. Often roadblocks last only as long as officers are available and end should there be a crash within the city, etc. and are therefore constrained by a lack of human resources. Moreover the police/traffic officers lack capacity in regards to the enforcement of the “zero tolerance law.” Although drivers can invoke the Pact of San José, police/traffic officers still have the authority to suspend licenses, impound vehicles, and or issue fines to those suspected of the behavior.

However, due to a recent change in the Brazilian legislation in December 2012, after the realization of the present study study, the police/traffic officers are now able to enforce the performance of breathalyzer or blood testing and in the case of refusal, are now empowered to arrest a driver suspected of this behavior and apply more severe penalties. Future studies of the prevalence of drink driving and alcohol associated crashes, injuries and deaths are necessary to determine whether the problem of the drink driving in Brazil is a matter of law or of the capacity to enforce the law

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Community Regulation of Alcohol Availability: Evidence of Effectiveness and Challenges for Implementation

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Abstract

Context
Regulation of the availability of alcohol has been found to be a very important factor in alcohol impaired driving, as well as other alcohol related problems. Such factors as minimum purchase age for alcohol, the density and location of alcohol outlets, and alcohol service and sales practices have all been found to be related to impaired driving. Recent research has added to knowledge about the potential for regulatory strategies to reduce alcohol impaired driving, giving communities additional tools for preventing alcohol related harm.

Objectives
This paper summarizes recent findings about alcohol regulation as related to impaired driving and will describe efforts to disseminate and facilitate the use of this information at the community level. It also describes some of the barriers to implementation of alcohol regulatory strategies. In particular, it highlights ongoing dissemination and education in a sample of cities in California (USA).

Key Outcomes
Local efforts to reduce alcohol impaired driving have included changing the alcohol environments on college campuses, improvements in enforcement of purchase age and responsible beverage service regulations, and zoning and licensing laws to regulate the density and location of alcohol outlets. Many of these strategies have shown positive results for drinking and driving as well as other alcohol related harm. Barriers to implementation of effective strategies include coordination among relevant agencies and groups, competing economic issues, and competing demands on enforcement resources.

Discussion and Conclusions
Research and evaluation have demonstrated that alcohol regulation is an effective and efficient way of preventing impaired driving. Many strategies can be implemented at the community level. Significant challenges must be overcome in order to optimize the use of these strategies.

Introduction

Alcohol is a commodity that is regulated at the federal, state, and local level in the United States. Some of these regulations are designed to insure that appropriate taxes and fees are collected. But regulations are also put in place to reduce a variety of alcohol related problems, including drinking by underage persons, violence, disorder, and illegal behavior associated with alcohol outlets, and other such problems. Among the problems addressed by regulations is alcohol impaired driving. Regulation of the availability of alcohol has been found to be a very important factor in alcohol impaired driving. Such factors as minimum purchase age for alcohol, the density and location of alcohol outlets, alcohol service and sales practices, and the price of alcohol have all been found to be related to impaired driving.

The development, establishment, and implementation of alcohol regulation at the federal and state level can be quite powerful and affect a wide population. Passing such regulations can be challenging, given the variety of interest groups that must buy in to these regulations and the number of obstacles that can be encountered. In some cases, implementation of local regulations can be more feasible and have important results for public safety in those localities.

This paper describes research that has added to knowledge about the potential for local regulatory strategies to reduce alcohol impaired driving at the local level, giving communities additional tools for preventing alcohol related harm. It also describes efforts to disseminate and facilitate the use of this information at the community level, including some of the barriers to implementation of alcohol regulatory strategies. In particular, it hightlights an ongoing dissemination and education project working with community agencies and organizations in a sample of cities in California (USA).

Types of local regulation

Local efforts to reduce alcohol impaired driving through regulation of alcohol availability have included:

- Improvements in enforcement of purchase age laws
- Establishment and enforcement of responsible beverage service regulations,
- Zoning and licensing laws to regulate the density and location of alcohol outlets.
- Changes in college campus environments

The evidence supporting each type of effort is described briefly below.

Improvements in enforcement of purchase age laws
In the United States, young drivers pose particular risks. Until they reach their mid- to late 20s, drivers have a higher crash risk, especially when crash rates are adjusted for exposure. Impairment by alcohol exacerbates these risks. (Voas et al., 2009; Gonzales et al., 2005). After the drinking age was changed to 21 in the U.S. in the 1980s, alcohol related crashes declined dramatically among drivers under 21. More vigorous enforcement of minimum purchase age has been shown to reduce sales to minors (Flewelling 2012; Wagenaar et al., 2005), reducing attempted underage alcohol purchases and self-reported underage drinking (Paschall 2012), and reducing single vehicle nighttime crashes among drivers under 21 (Holder et al., 2000).

Many communities in the U.S. have implemented programs to reduce sales to minors, mainly focusing on enforcement campaigns utilizing decoy purchasers. These enforcement programs are usually combined with information campaigns aimed at alcohol outlets and public awareness.

Establishment and enforcement of responsible beverage service regulations
Establishment and enforcement of regulations requiring responsible beverage service by alcohol outlets can have an impact on impaired driving. Especially effective is enhanced enforcement of

laws against sales/service to intoxicated patrons. Studies in two U.S. locales found that when outlets were informed about enforcement campaigns and later visited by undercover police the percentage of driving under the influence (DUI) arrestees who reported having consumed their last drink in an intervention setting decreased by 31-36 % (Ramirez et al., 2008; McKnight and Streff, 1994).

Many localities have implemented a variety of regulations and programs aimed at educating the management and servers in bars and restaurants that serve alcohol. These educational programs appear to be most effective when they are backed up by well-publicized enforcement of laws against over-service of alcohol.

Zoning and licensing laws to regulate the density and location of alcohol outlets

There is good research evidence that density of alcohol outlets is associated with alcohol-related motor vehicle crashes and other alcohol related harms (Campbell et al., 2009). Studies consistently find significant correlations between how easily and conveniently alcohol is available and the occurrence of traffic crashes, even when many of the other features of the local environment are taken into account (Gruenewald, 2007). These relationships have been examined over time within specific zip codes, showing that changes in numbers of bars and off-premise establishments over time are related to changes in rates of alcohol-related crashes (Treno, 2006).

The question is sometimes raised as to whether creating high density in which drinkers don't have to drive far to get to an outlet might reduce their risk of having a crash. In fact, when studied in communities, this reduction due to reduced exposure to driving risk is overwhelmed by greater frequencies of drinking due to greater availability of alcohol and greater opportunities for drinking in environments (such as at bars and restaurants) where the patron is likely to drive after drinking. There are more traffic crashes in neighborhoods with greater numbers of alcohol establishments, with most crashes occurring in areas where drinkers are driving away from outlets toward residential areas (Gruenewald and Treno, 2000).

Changing College Campus Environments

College students tend to have risky drinking patterns, including driving after drinking. The density of outlets around campuses has been shown to affect heavy drinking and drinking problems among students (Weitzman et al., 2003). Studies have shown, however, that changes in the alcohol environments on and around college campuses can reduce risky drinking and impaired driving. These interventions often combine the strategies described above. In one study, universities in California were randomly assigned as intervention and control schools. Interventions included 1) nuisance party enforcement operations that stepped up police response to disruptive parties, 2) minor decoy operations to prevent sales of alcohol to minors, 3) driving-under-the-influence checkpoints, and 4) social host ordinances that held party hosts or organizers responsible for nuisance parties. Campus and local media were used to maximize the visibility of environmental strategies. The results showed that students were significantly less likely to become intoxicated at intervention universities compared to the control campuses. Significantly fewer students at the intervention schools also reported that they became intoxicated the last time they drank at an off-campus party; a bar or restaurant; or across all settings (Saltz, 2010).

In another study, the intervention included a social marketing campaign, with prevention advertisements in the school newspaper, ads posted in public areas on campus, and ads distributed as postcards. The message in the ads warned students that "Drinking Driving Laws Are Strictly Enforced in the College Area." These advertisements were backed up by strong media coverage on the local community stations and in the college paper. DUI checkpoints were operated by the campus police, with assistance from local city police and the highway patrol. The results showed a considerable drop in the students' reports of driving after drinking (Clapp et al., 2005).

Barriers to implementation of effective local strategies

The literature is clear that several strategies for changing the local alcohol environment have the potential for reducing impaired driving as well as other alcohol related problems. Communities face many challenges to the implementation of these strategies.

One serious barrier is the lack of information easily accessible to communities about these strategies. While studies are published in professional journals, often these resources are not available to or in appropriate language for community leaders, regulators, and concerned citizens (Stewart, 2005). .

Other barriers to implementation include other health, safety, and social problems that compete for local attention and resources. For example, while enforcement of underage drinking laws and laws against sales of alcohol to intoxicated patrons are known to be effective, enforcement agencies typically have many competing concerns and these types of enforcement may be given a low priority.

Another challenge that local communities face is the competing economic interests of alcohol sales and service establishments. Restrictions on outlet density or enforcement of sales regulations are often perceived as cutting into profits of local businesses and tax revenues available to the locality.

Establishment and implementation of effective regulations can be difficult. Many communities tend to prefer to work on easier strategies – for example, education programs in the schools. Many of these strategies lack the strong level of effectiveness of the strategies described here but may distract from more effective approaches.

Promoting the adoption of effective local strategies

The Prevention Research Center (PRC), as part of its Center Grant from the U.S. National Institutes on Alcohol Abuse and Alcoholism, is working to assist communities in learning about, selecting, and implementing effective strategies. Researchers at PRC carry out some of the most relevant research on environmental strategies to reduce alcohol harm, including those that occur at the local level.

Education and dissemination activities include making research findings accessible to communities through translation and synthesis of research findings into clear guidance for policy makers, advocacy groups, and concerned citizens. Communications channels include a website, periodic newsletters, social media, and presentations to organizations trusted by localities. We have also worked directly with a sample of communities in California to adapt research findings to local conditions and share experiences of implementation from community to community.

These activities have been well received, but are labor intensive. Especially in times of reduced resources, even getting the attention of local organizations and agencies is challenging. In order to overcome some of these difficulties, we are in the process of developing a web-based tool to aid in planning and implementation of environmental strategies at the local level.

Conclusions

Research and evaluation have demonstrated that alcohol regulation is an effective and efficient way of preventing impaired driving, creating healthier community environments with respect to the availability and use of alcohol. Many of these strategies can be implemented at the community level. Significant challenges must be overcome in order to optimize the use of these strategies. We are designing and implementing dissemination techniques to aid in the adoption of effective strategies and improvement of community safety.

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Drink Driving Prevention Initiatives in Low- and Middle-income Countries: Challenges and Progress in Nigeria and Vietnam

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Context
Many low- and middle-income countries have not shared the progress in drinking and driving prevention experienced in higher income countries around the world. These countries bear a disproportionate burden of injury and death resulting from traffic crashes, including those resulting from impaired driving. Understanding the economic, legal, and cultural context of these countries is important to the development of effective drink driving prevention programs. This paper highlights the nature of the drink driving problem and ongoing prevention intervention programs in Nigeria, a low-income country and Vietnam, a lower-middle income country.

Objectives
A situation assessment was carried out in each country to identify the most serious challenges and possible points of intervention. In Nigeria, commercial drivers, including drivers of oil tankers and of buses, were identified as at particular risk of drinking and driving. The program implemented to address this problem included involving drivers' unions as partners in changing driver behavior as well as educating alcohol sellers at highway rest areas. Sobriety checkpoints were implemented to measure driver BAC at baseline and as the program progressed. In Vietnam, two-wheeled motor vehicles account for the bulk of traffic. The need for greater public awareness of drinking and driving as a safety problem and the need for better drink driving enforcement were identified as key issues. Public awareness and enforcement training programs were implemented. Public opinion surveys and roadside breath testing were carried out at baseline and as the program was implemented.

Key Outcomes
Roadside surveys are measuring the number of drinking drivers of tankers and buses in Nigeria. Results from the surveys thus far are presented. In Vietnam, opinion surveys have shown greater public awareness and concern about drinking and driving. Roadside surveys are measuring changes in alcohol impaired driving. The results thus far are presented.

Conclusion

Reducing drinking and driving in low and middle income countries is a challenging task but when interventions are tailored to local conditions and needs, progress can be made. Experience with the projects has also shown the importance of effective partnerships with local governmental and nongovernmental organizations.

Introduction

A great deal of progress has been made in reducing alcohol impaired driving crashes and the related injuries and deaths in countries around the world (GRSP 2007). Most of this progress has been in high income countries with mature road safety policies. The reductions in drink driving have resulted from a combination of more stringent laws, more vigorous enforcement, and changing social norms. Unfortunately, this progress has not been shared by many low and middle income countries. These countries continue to experience great social and economic harm as a result of drink driving (GRSP 2007).

The dangers inherent in drink driving are exacerbated in many low and middle income countries by infrastructure that is less protective, vehicles that are less safe, and the presence of many vulnerable road users (pedestrians, cyclist, motor scooters and motorcycles). This overall road safety problem is indicated by the fact that over 90% of the world's fatalities on the roads occur in low-income and middle-income countries, which have only 48% of the world's registered vehicles (WHO 2009). It is expected that without adequate policies the number of fatalities and injuries will continue to increase in low and middle income countries. Driving under the influence of alcohol will continue to play a significant part in these crashes.

Many high income countries have reached a plateau in their efforts to further reduce drink driving crashes and are making initial steps towards adopting ever more stringent or technologically sophisticated strategies to accomplish further reductions. Many low and middle income countries, by contrast, have yet to implement even minimal public education, legal, or enforcement approaches to combat drinking and driving and the application of more technologically advanced strategies may only occur in the distant future.

The Drink Driving Initiative

In response to this disparity, international organizations are working to assist low and middle income countries to reduce drink driving and the resulting deaths and injuries. Among these efforts is the Drink Driving Initiative of Global Actions on Harmful Drinking (see http://www.global-actions.org/globalactions/DrinkDriving) being carried out through the International Center for Alcohol Policies (ICAP). The initiative combines global and local action in partnership with government, industry and community stakeholders, with a focus on six low- and middle-income countries where drink driving is a significant issue. These countries are China, Colombia, Mexico, Nigeria, Russia and Vietnam.

In each of these six countries, the initiative has sponsored a situational assessment to provide an overview of the current status of drink driving in the country. Following the advice of the *World report on road traffic injury prevention* (WHO 2004) and the global good practice guide on drinking and driving (GRSP 2007), these assessments included a review of available statistics and a critical appraisal of current practices (Johnson 2012). The results of these assessments were used to select specific local regions or cities for intervention. Locally tailored capacity-building and training events took place. Projects have been implemented, customized to accommodate regional factors such as levels of development, road conditions, and patterns of alcohol consumption and harm. Ongoing monitoring and outcome evaluation are taking place. This paper highlights two countries included in the initiative: Nigeria and Vietnam.

Challenges and Opportunities

It is important to note that the traffic safety and drink driving problems of low and middle income countries are different not just in quantity but in basic qualities from those in high income countries. For example, to varying degrees, these countries are confronting rapid economic growth and, along with that, rapid motorization. More and more of the population is able to afford motor vehicles. Often these vehicles are used in environments that lack well-engineered roadways and other physical infrastructure that can contribute to safety. The legal and policy infra-structures in these countries are also often lacking basic elements, such as clear blood or breath alcohol limits for drivers and rigorous driver licensing standards. Enforcement of the laws that do exist is sometimes hampered by a lack of training and equipment as well as troubled relationships between law enforcement officers and the public. Alcohol has also become more affordable to the population in some countries. At the same time, alcohol control policies vary widely and where they do exist, are sometimes subverted by the availability of unregulated alcohol from non-commercial sources. Media promotions of alcohol and cultural acceptance of alcohol use can also add to the difficulties in preventing drinking and driving in some countries. The combination of increased use of private transport for social activities (particularly in Asia), and the drinking culture exacerbates the risk. Alcohol use in commercial transport is also common in some countries (Stewart, et al., 2012).

Attitudes among the general public about drink driving vary among these countries. In many high income countries, knowledge of the dangers of drink driving and social attitudes condemning it are widespread. This is not the case in many low and middle income countries, where social norms against impaired driving may have not yet developed. In addition, all of these countries confront other threats to health and safety that compete for public and government attention and limited resources.

A problem confronted by all the countries included in the initiative is a lack of thorough and reliable data on crashes and alcohol involvement in crashes. In addition to and interrelated with recording problems are problems with basic enforcement. Traffic police do not always have the equipment and training needed to record breath alcohol levels and use judgment to identify drivers who have been drinking. Corruption among police can be an issue. The result is, in some cases, weak enforcement. In addition, the poor and incomplete data make it difficult to compare countries, to analyze specific problems, and to track changes. For policy makers there is little evidence on which to base decisions.

Vietnam

Background

Vietnam has experienced phenomenal growth in motor vehicles especially motorcycles in the last decade (400%). This initially led to an increase in deaths from road crashes but since 2006 the number has stayed fairly level according to police statistics. Comparisons with health data, however, suggest that the number of deaths is much higher and there are clearly a number of problems with the relevant data systems. Data on the percentage of drivers exceeding legal limits is not available but police statistics indicated that 3-7% of crashes involve alcohol. This is likely to be an underestimate as the police and health services do not have the equipment to measure BAC levels of all drivers in crashes. Motorcycles represent 80% of the traffic on the road and they also account for the largest proportion of road users found to be drinking and driving. For example between 2001 and 2003, 71% of road users tested positive for alcohol were motorcyclists (Luu et al., 2012). The legal system includes strict limits and severe punishments for drunk drivers involved in serious crashes. However the police do not have adequate manpower or equipment to conduct regular and frequent road-side checking for drivers who have been drinking. There have also been a number of education programs on drinking and driving but these have not included sustained and intensive campaigns targeting the high risk groups.

Program
In response to the situation described above, a program was designed and implemented in Vietnam, focused on Da Nang City. It included three main components implemented in five waves:

- Capacity building training courses for health workers (to take BAC measures on crash victims), police (to carry out roadside breath testing), and community leaders (to coordinate efforts and carry out publicity campaigns).
- Communication campaigns including television and radio, ward/village loudspeaker systems, community meetings, newspapers and magazines, posters, banners, flyers, and programs in workplaces, hospitals, and schools including contests, oral presentations, amateur dramatics, and exhibitions.
- Enhanced enforcement, including random roadside breath testing.

Results
Prior to the implementation of this program, Da Nang traffic police did not carry out random roadside breath testing. In the first campaign of the project, during one month, 2,097 drivers were stopped and tested. Of these, 6.2% were found to be over the legal limit of .05 (82 cases). Unfortunately, subsequent enforcement waves did not occur. The reason given by enforcement agencies was a lack of equipment.

Testing of traffic crash victims showed that the proportion of tested blood samples above the legal alcohol concentration was reduced from 62.9% to 56.5% after one month of conducting the communication activities and enforcement enhancements.

In general, public awareness of the campaign increased over the course of the program, reaching 70% to 90% by the final survey wave, an increase of 17 percentage points. Specific areas in which awareness and opinion changed were awareness of the alcohol limit (increasing from 7% to 40%), agreeing that it is not advisable to drive within two hours of drinking (76% to 92%). Increases were also seen in support for penalties. The proportion of survey respondents reporting driving within two hours after drinking decreased after each campaign, from 30.2% to 12% after the last campaign.

Local program coordinators concluded that political will was a very important factor in achieving results. In Da Nang, there have been 91 official orders and decisions issued during two years of project implementations. The leaders at both city and district levels attend many events and workshops.

Support from key government bodies has been very important in Vietnam, a country with a strong central planning system. ICAP and the National Traffic Safety Committee established the

Project Steering Committee and Project Working Group at the central level. Da Nang City Traffic Safety Council established the Project Management Board and Project Working Team. At the district level, similar systems have been established. All the work is carried out per the signed Project Management Mechanism from central to city to district, both top down and grass root up.

Nigeria

Background

A comparison of Nigeria's crash statistics with those of other countries shows that the rate of fatal road traffic crashes in the country is one of the highest in the world. General observations attribute this high rate of road crashes to a number of reasons, including the poor condition of many Nigerian roads and highways, vehicles that are not road-worthy, excessive speeds, illiteracy of drivers; and drink driving. There is a low level of awareness about the legal blood alcohol concentration (BAC) level, and that it is rarely mentioned in public discourse about alcohol-related problems. The average driver who drinks beverage alcohol does not know or understand what BAC means. This situation assessment carried out by ICAP indicated that commercial vehicle drivers are a major contributor to drink driving incidents in Nigeria. In particular, commercial drivers engaged in long distance journeys are at risk (Ogazi and Edison, 2012). Their habit of drinking and driving is linked to the pervasive perception that drivers need to consume alcohol in order to remain alert while on a journey.

The sale of both branded and unbranded beverage alcohol products at motor parks and mid-highway towns where drivers stop to rest and refresh are serious contributory factors to drink driving. In informal motor parks, some drivers (who often come from distant towns and do not have a home to stay in or cannot afford to pay for a hotel) sleep in the parks.

Program

The intervention in Nigeria includes two target groups of professional drivers: Drivers of commercial passenger buses and drivers of petroleum product tankers. Both of these groups drive on heavily traveled roads and can pose serious risks to passengers, other road users, and the surrounding areas. There have been a number of fatal crashes and popular rest points offer alcoholic beverages to drivers.

The intervention for drivers is designed to:

- Increase the capacity of the road safety officials to conduct random checks for breath alcohol concentration
- Explore issues related with drink driving among bus and tanker drivers who ply this route
- Educate alcoholic beverage sellers about the dangers of selling alcoholic beverages to all drivers especially bus and tanker drivers.
- Mobilize public support for stricter drink drive laws by informing them about the dangers involved with a permissive culture regarding drink-driving among drivers.

Road safety officials pull over the drivers of buses and tankers to test the breath alcohol concentration levels while research assistants administer questionnaires on the drivers to explore origin and destination as well as places where alcohol might have been consumed.
The intervention also included education of unions to which drivers belong and distribution of Information, education and communication materials on the dangers of drink-driving, including handbills and posters. A carnival was also put on at roadside rest areas aimed at general public awareness of the dangers of sale of alcohol to long-distance drivers while on duty.

Results
Results of the first survey indicated that the vast majority of drivers were unfamiliar with Nigerian laws about drinking and driving and thought that their chances of being stopped by law enforcement were very small. A follow-up survey carried out among the same set of drivers within a three month period showed a significant change in awareness of drink drive laws. Breath tests of bus drivers at baseline found approximately 11% positive for alcohol, with 5% over the legal limit. Among tanker drivers, 16% were positive for alcohol and 3% were over the legal limit. There was no significant change from baseline to the second round of testing.

Conclusions

The challenges in each of the countries included in the initiative are daunting. It is necessary, to find ways of adapting strategies that have worked in high income countries for use in low and middle income countries. Experience in Vietnam and Nigeria indicates that the progress can be made but programs confront challenges. The baseline level of awareness and concern in Nigeria, for example, is very low even among professional drivers. While awareness in Vietnam was relatively high and increased over the course of the campaigns, enforcement elements were not fully implemented due to lack of resources. Persistence and continued creativity and adaptability are needed in order for progress to be made.

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Cumulative prevention benefits and costs saved by drinking driving policies: Estimates for Ontario, 1970-2006.

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Abstract

Background: Progress in assessing the impact of specific policies on the drinking driving problem, and advances in valuing the avoidable costs that result from alcohol-related problems suggest that estimating the impact of policies can be determined with a precision that has not previously been possible. *Aims:* Using research-based estimates of the effects of drinking driving policies in Ontario and elsewhere, we estimate their impact in terms of deaths, injuries, and collisions prevented and costs saved. *Methods:* Estimating these benefits required three steps: 1) reviews of studies to estimate the impact of successful drinking driving policies in Ontario (legal limit (per se) law, raising drinking age from 18 to 19 years, remedial measures, RIDE spot-check program, graduated licensing, administrative licence suspensions, and maintaining the public monopoly on alcohol sales); 2) calculation of 'prevention benefits' to estimate the numbers of deaths, injuries, and collisions prevented; and 3) application of monetary values derived from two methods (human capital – discounted future earnings, willingness to pay) to estimate costs averted. We estimated the total deaths, injuries, and collisions prevented and costs averted for each policy from the year of its introduction to 2006. *Results:* Between 1970 and 2006, drinking driving policies and programs prevented an estimated total of 4,887 deaths, 178,238 injuries and 132,182 property damage only collisions in Ontario, and total costs averted were estimated at $8.5 Billion (human capital – discounted future earnings method) or $78 Billion (willingness to pay method). *Discussion and Conclusions:* These results suggest that drinking driving policies have been of substantial cumulative value to society in preventing deaths, injuries, collisions, and monetary costs.

Background

According to the Centers for Disease Control[1] and the Canadian Public Health Association,[2] the reduction in collision deaths over the past several decades is a significant public health success, and a major component of that success has been the prevention of impaired driving. In Ontario, the proportion of fatally injured drivers who were positive for alcohol declined from 58.7% in 1981[3] to 26.4% in 2006.[4] However, estimation of the cumulative magnitude of successful drinking driving prevention initiatives, in terms of deaths and injuries prevented or costs averted, has not been undertaken. Recent progress in assessing the impact of specific policies on the drinking driving problem,[5-9] and advances in valuing the avoidable costs that result from collisions and alcohol-related problems[10-12] suggest that useful estimates can now be calculated. Providing a more comprehensive picture of the benefits of policies and programs to prevent drinking-driving may provide support for road safety initiatives in the future.

Aims

This study estimates the impact of drinking driving policies and programs in Ontario between 1970 and 2006 using research-based estimates of the effects of these policies and programs. These are combined with methods derived from recent estimations of the costs of collisions and alcohol-related problems,[12-17] to estimate the benefits for Ontario in terms of deaths, injuries, and collisions prevented and costs averted.

Methods

Estimation and valuation of drinking driving policies in Ontario required these steps: 1) effective policies and their estimated impact on drinking driver fatalities were identified in the literature; 2) these estimates were used to calculate the number of deaths, injuries and property damage collisions prevented by each policy from its introduction to 2006; 3) estimates of the costs averted by each fatality, injury and property damage collision prevented were obtained; and 4) total benefits were estimated for each policy, in terms of reduced deaths, injuries and collisions, and averted costs. Policies examined were: legal limit (per se) law (1969), raising the drinking age from 18 to 19 (1979), remedial measures (1999), RIDE (province-wide spot check program) (1980), graduated licensing (1994), administrative licence suspensions (1996), and maintaining the public monopoly on alcohol sales (LCBO) (1995 and 2005). Although ignition interlocks were introduced during this period, insufficient data were available to estimate their provincial level impact during this period.

Systematic literature review identified studies that assessed the impact of specific drinking driving policies in Ontario and meta-analyses or studies of similar policies introduced in other jurisdictions. The identified policies' impact (see Table 1) were then used them to estimate the magnitude of the drinking driving problem in Ontario had these measures not been introduced.

Based on evaluations of the impact in Ontario of the legal limit (per se) law, RIDE, administrative license suspensions, and remedial measures, an estimated attributable fraction representing a reduction in drinking drivers or total fatalities was available from randomized trials or time series analyses.[18-23] The impact for the legal limit law,[18,23] administrative suspensions[19,22,24] and remedial measures[21] was obtained directly from Ontario studies. Corresponding estimates from other jurisdictions and from meta-analyses[7-8,24-26] provided comparable estimates of impact. Thus calculations were based on an 18% reduction in drinking driver fatalities for the legal limit law[18,23], a 17% reduction in drinking driver fatalities for administrative license suspensions,[29,22,24] and for remedial measures a 30% reduction in mortality rate among remedial program participants.[21]

The impact for RIDE was taken from a meta-analysis[7] because the Ontario study[20] did not present an attributable fraction. The estimate of impact on fatalities was only applied for the month of December, when RIDE is most often applied. Thus calculations were based on a reduction of 20% for fatal and injury crashes, and 24% for other crashes in December.[7]

For raising the legal drinking age from 18 to 19 and for graduated licensing, research demonstrating a positive impact on self-reported drinking driving in Ontario was available[27] or was undertaken.[28] Since evidence of a positive impact was available in Ontario, estimates of impact on fatalities from meta-analyses of the effects of these measures in the published literature were then employed.[7-9] For raising the drinking age from 18 to 19, calculations were based on a 4% reduction in fatalities among 18 year-olds, since a 12% reduction was found for 18-21 year-olds.[7] For graduated licensing, calculations were based on a 19.1% reduction in fatalities among 16-17 year olds.[9]

Finally, for the two instances (1995, 2005) when the Ontario government considered selling the LCBO but chose to maintain public control, the lower estimate (10%) of the projected impact of privatization on average consumption levels[29] was used to estimate the impact that increased alcohol consumption would have had on alcohol-related fatality rates. These estimates were based on known relationships of average consumption levels with mortality rates[25,30] and of the expected impact of privatization (e.g.,[31]).

To estimate the number of deaths prevented, the total number of drinking driver deaths was first estimated from Ontario Road Safety Annual Reports (ORSAR) data from 1970 to 2006 (i.e., driver fatalities, alcohol-positive drivers in those tested, injured drivers, and those involved in property damage only collisions). The number of driver fatalities was multiplied by the proportion of alcohol-involved drivers in those tested to provide an estimate of the total number of drinking driver deaths per year. The benefit, or the impact of the policy in terms of deaths prevented, was calculated by estimating the expected numbers of drinking driver fatalities based on the reduction in fatalities observed with the introduction of the measure. Thus, for example, the impact of the per se law was an 18% reduction in drinking driver fatalities. If the drinking driver fatalities observed is the result of an 18% reduction in fatalities, then the expected number without the per se law would have been 22% higher. Thus the number of drinking driver fatalities observed minus the number expected without the law equals the estimated number of drinking driver deaths prevented.

The number of other fatalities prevented when drinking driver fatalities are prevented (hereafter referred to as collateral fatalities prevented) was estimated. Connor and Caswell[35] reported the number of victims involved in impaired driver fatalities is about 40% of the numbers of drinking drivers killed; therefore, 40% of the numbers of drinking driver fatalities prevented were estimated to be the numbers of collateral fatalities prevented.

Following the calculation of drinking driver and collateral fatalities prevented, the numbers of injuries and property damage collisions prevented were estimated. For most of these measures, the following procedures were followed. The numbers of drivers injured and property damage collisions were obtained from the ORSAR reports. The number of drinking driver injuries and property damage collisions were estimated by applying proportions suggested by Cherpitel's[33,34] emergency room studies, with 2/3 of the proportion of alcohol-positive fatally injured drivers used to estimate the numbers of injured drivers who had been drinking, and 4/9 of the proportion of alcohol-positive fatally injured drivers used to estimate the number of collisions that involved a drinking driver. From the resulting figures, 40% were estimated to be collateral injuries or property damage collisions.

For raising the legal drinking age from 18 to 19, analyses were restricted to only those collisions that involved an 18 year-old driver, and for graduated licensing, analyses were restricted to only drivers aged 16 and 17 as noted earlier. For the remedial measures program, the number of all fatalities that would be expected in participants in Ontario's drinking driver program between 1999 and 2006 were estimated, assuming no treatment occurred, based on the overall fatality among untreated convicted drinking drivers of 1.2% per year observed by Mann et al.;[35] a similar fatality rate found in Finland.[36] That number was then reduced by the reduction in mortality rate of 30% observed in the randomized trial by Mann et al.;[21] a conservative estimate in comparison to 50% reduction in mortality rate for brief interventions found in the meta-analysis reported by Cuijpers et al.[26] In calculating the estimated reductions in injuries and property damage collisions, the numbers were reduced by a further 50% because the total fatalities also included about 50% deaths from causes other than collisions.[21,35]

For maintaining the LCBO (1996 and 2006), we estimated that privatizing alcohol sales would increase alcohol consumption levels by 10%[29] and estimated increases in alcohol-related collision fatality rates of 12.9%.[30]

Estimates of financial costs were obtained from two sources. The first was the Canadian Cost Study on Substance Abuse[13,14] where estimates were based on a hybrid of the human capital and discounted future earnings methods for 2002. This resulted in estimated costs (in 2006 dollars adjusting for inflation) of $235,875 for a fatality, $36, 290 for an injury ($36,290), and $7,554 for a property damage collision. The second source was the Vodden et al.[37] willingness to pay methods to estimate costs for 2004. This resulted in estimated costs (in 2006 $$ adjusting for inflation) of $14,248,720 for a fatality, $45,051 for an injury, and $8,382 for a property damage collision. These methods to estimate the costs averted, provide a range of effects from a conservative approach, a hybrid of the human capital and discounted future earnings methods,[13,14] to a more inclusive willingness to pay methodology.[37]

Based on the preceding assumptions, the benefit was estimated for each of the policy initiatives. First, observed total numbers of deaths, injuries, and property damage collisions per year, involving both drinking drivers and collateral victims, were calculated based on ORSAR data (1970-2006) and applying procedures described previously. Next, the expected deaths, injuries and property damage only collisions that would have occurred without each initiative were calculated, based on observed impacts of these initiatives as described. Subtraction (expected – observed) yielded the total benefit for each policy per year in terms of deaths, injuries and property damage collisions prevented. Costs averted were then calculated applying the two methods for estimating the costs described above.

Results

Total benefits of drinking driving policies and programs considered here has been substantial (see Table 2). An estimated 3,555 drinking driver deaths and 1,285 collateral victim deaths were prevented in Ontario by these policies. In general, policies in place the longest accrued the largest estimated benefits. Thus, Canada's legal limit law is estimated to have prevented 2,194 drinking driver deaths and 878 collateral victim deaths between 1970 and 2006. The next largest impact is for remedial measures (estimates of fatalities prevented also include deaths from causes other than collisions, since the mortality rates were from all causes of death), estimated to have prevented 684 drinking driver deaths and 137 collateral victim deaths. It is also apparent that the numbers of injuries and property damage only collisions prevented are much larger than the numbers of fatalities prevented. An estimated 126,423 drinking driver injuries and 49,602 collateral victim injuries were prevented, and an estimated 93,867 drinking driver and 36,666 collateral victim property damage only collisions were prevented. Similar trends are observed with injuries and property damage collisions as seen with fatalities. Thus, the legal limit law prevented the largest numbers of injuries and property damage only collisions, and laws aimed at young people prevented the smallest number. Nevertheless, graduated licensing is estimated to have prevented 266 drinking driver injuries and 105 collateral victim injuries since 1994.

Estimates of costs averted by these programs and policies are substantial (see Table 3). Using cost estimates from the human capital and discounted future earnings method[13,14] the total costs averted due to prevented fatalities are estimated to be $1,142 million. The estimated costs averted accruing from prevented injuries ($6,388 million) is larger than from prevented fatalities, due to the much larger number of injuries. The costs avoided follow similar patterns for property damage only collisions. Canada's legal limit law is associated with the largest costs averted. Costs averted using the willingness to pay method[37] are substantially larger, primarily because the value of a fatality prevented is much higher. The costs averted due to prevented fatalities are $68,962 million. The overall total costs averted are $77,986 million. The distribution of costs averted due to specific policies is similar to that noted above using the human capital and discounted future earnings method. The smallest costs averted accrue to policies targeting young drivers. However, even here the costs averted are substantial, with the smallest effect, for raising the legal drinking age from 18 to 19, resulting in estimated total costs averted of $215 million over the years since its introduction.

Discussion and conclusions

This study presents research-based estimates of the benefits in Ontario resulting from drinking driving policies and programs initiated between 1970 and 2006. Evaluations of the impact of these policies and similar policies elsewhere, as well as advances in methods to estimate costs and attribute benefits, allow the opportunity to estimate the cumulative impact of these measures, and that impact is substantial.

The work described here is of interest for several reasons. An empirically-based method for cumulative valuing of prevention activities is demonstrated that shows the substantial value of drinking-driving prevention policies and programs, and thus provides a useful tool for future research. The failure to devote adequate resources towards research on preventing health and safety problems has been noted as a failure of vision and action in determining resource allocation in health and safety systems.[38,39] Nevertheless, the lack of information on specific and quantifiable benefits from prevention research and practice is likely a factor in decisions on the allocation of resources, and this study demonstrates the substantial health, safety and economic value that can accrue as a result of evidence-based prevention initiatives.

The estimates arrived at here are based on research-based estimates of the impacts of these drinking-driving initiatives, and on estimates derived from economic research of the value of fatalities, injuries and collisions. In applying these estimates of impact across years, a consistent level of impact is assumed. While some studies have found evidence for non-linear effects of drinking driving initiatives (e.g.,[43]), studies examined to obtain the values used here presented evidence for linear effects. No estimate is made for other drinking driving initiatives that occurred in this interval, e.g., the considerable amount of public education on the impaired driving issue that has occurred, because little information on aggregate-level effectiveness of these initiatives is available.[27]

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Table 1: Effective drinking driving policies in Ontario and research on their impact.

Policy	Effective	Research on Ontario	Other research (selected)	Policy's impact on fatalities (reduction)
Legal limit (per se) law	1970	[18]Asbridge et al., 2004 [23]Mann et al., 2006	[7]Shults et al., 2001 [8]Tippets et al., 2005	**18%** in drinking driver fatalities
Raise drinking age 18 to 19	1979	[28]Paglia-Boak et al., in prep	[7]Shults et al., 2001	**4%** among 18 year-olds
Remedial measures	1999	[21]Mann et al., 1994	[26]Cuijpers et al., 2004	**30%** among program participants
RIDE program	1980	[20]Donelson et al., 1986	[7]Shults et al., 2001	**20%** in fatal and injury crashes, **24%** in other crashes in December
Graduated licensing	1995	[27]Mann et al., 1997 [28]Paglia-Boak et al., in prep.	[9]Vanlaar et al., 2009	**19.1%** among 16-17 year-olds
Administrative license suspensions	1997	Mann et al., 2002 [19]Asbridge et al., 2009	[24]Wagenaar et al., 2007	**17.3%** in drinking driver fatalities
Maintaining alcohol monopoly	1996 2006	[29]Her et al., 1998 [30]Mann et al., 2005	[25]Babor et al., 2003	**12.9%** in alcohol-related crash fatalities

Table 2: Deaths, injuries and property damage only collisions prevented due to policies in Ontario, 1970-2006.

Policy	Drinking driver deaths	Collateral victim deaths	**Total deaths**	Drinking driver injuries	Collateral victim injuries	**Total injuries**	Drinking driver property damage collisions	Collateral victim property damage collisions	**Total property damage collisions**
Legal limit (per se) law	2,194	878	3,072	93,180	37,272	130,452	59,704	23,882	83,586
Raise drinking age 18 to 19	9	4	13	818	327	1,145	554	222	776
Remedial measures	684	137	821	4,837	967	5,804	4,405	881	5,286
RIDE program	194	78	272	4,047	1,619	5,666	6,284	2,514	8,798
Graduated licensing	10	4	14	266	106	372	822	329	1,151
Administrative license suspensions	252	101	353	12,533	5,013	17,546	11,865	4,746	16,611
Maintain alcohol monopoly 1996	227	91	318	11,509	4,604	16,113	10,553	4,221	14,774
Maintain alcohol monopoly 2006	17	7	24	814	326	1,140	857	343	1,200
TOTALS	3,587	1,300	4,887	128,004	50,234	178,238	95,044	37,138	132,182

Table 3: Costs averted (in Canadian 2006 dollars) from 1970 to 2006 in Ontario.

Policy	**Willingness to pay method $**			**Human capital – discounted future earnings method $**		
	Deaths	**Injuries**	**Property damage collisions**	**Deaths**	**Injuries**	**Property damage collisions**
Legal limit (per se) law	43,762,791,298	5,876,976,343	700,585,446	724,454,007	4,734,072,386	631,400,497
Raise drinking age 18 to 19	164,752,250	45,107,820	6,024,801	2,727,327	36,335,638	5,429,833
Remedial measures	11,696,488,051	261,475,843	44,306,881	193,624,935	210,626,264	39,931,441
RIDE program	3,870,944,775	255,266,293	73,741,321	64,080,041	205,624,293	66,459,141
Graduated licensing	202,147,644	16,768,173	9,643,829	3,346,374	13,507,242	8,691,471
Administrative license suspensions	5,018,312,892	790,476,112	139,229,530	83,073,697	636,751,097	125,480,189
Maintain alcohol monopoly 1996	3,910,475,568	632,748,989	110,489,071	64,734,438	509,697,393	99,577,938
Maintain alcohol monopoly 2006	336,168,209	51,323,300	10,057,239	5,564,965	41,342,385	9,064,056
Total	**68,962,080,686**	**7,930,142,872**	**1,094,078,117**	**1,141,605,784**	**6,387,956,697**	**986,034,567**
TOTAL for each method	**$77,986,301,675**			**$8,515,597,048**		

Changing Trend of Drug Driving Detections in South Australia

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Abstract

Context
Driver drug testing has been operating in South Australia since 1 July 2006. The established regime targets 3 illicit drugs being Methylamphetamine, Delta 9 Tetrahydrocannabinol (THC) and 3,4 Methylenedioxymethamphetamine (Ecstasy). These drugs are represented in drivers and riders involved in fatal road crashes in South Australia. Drivers and riders are tested in a predominantly random roadside testing environment using oral fluid in a two stage testing process followed by a laboratory confirmation process for those drivers who provide a presumptive positive sample.

Objectives
To present the success of the driver drug testing regime that has been established in South Australia and examine the changing trends in drug detections between 2010/2011 and 2011/2012.

Key Outcomes
South Australia Police (SAPOL) screens 47,000 drivers for drugs per year. With a population base of 1.66 million people, SAPOL screens drivers for drugs approximately 4 times greater than any other Australian jurisdiction. SAPOL has decentralised its driver drug testing functions across the jurisdiction and has significant training requirements for its officers to undertake this task. This training requirement coupled with the long term establishment of officers conducting these duties is seen as a contributing factor in the success of drug driving detections in South Australia.

Discussion and conclusions
South Australia has seen a significant increase in its detection rate to Methylamphetamine between 2010/11 to 2011/12 with an associated decrease in the detection rate to THC. A significant increase in Ecstasy detections with detection levels back to those seen in 2009 was also observed. Overall, a marked increase in the detection of drugs in drivers has been noted with an increase of 41% in the overall detection rate of drugs for the 2011/2012 year compared to the previous 12 month period. There is a belief that the change in trends as to the types of drug detected in South Australian drivers is seen as an availability issue to the types of drugs. It is believed the significant rise in the overall drug detections amongst South Australian drivers is as a result of enforcement techniques as opposed to a general increase in drug driving prevalence.

Introduction
Research shows that the consumption of certain illegal drugs can negatively impact upon the driving task in a similar manner to alcohol impairment. In July 2006 the South Australian Parliament proclaimed legislation making it an offence to drive or attempt to drive a motor vehicle while a proscribed drug is present in your oral fluid or blood.

The drugs proscribed pursuant to this legislation are:

- Methylamphetamine (Speed)
- Delta 9 –Tetrahydrocannabinol
- 3,4-methylenedioxymethamphetamine (MDMA or Ecstasy)

Over the 6 year period that South Australia Police (SAPOL) has been testing drivers for drugs there has been a significant increase in the detection rates of drivers identified with drugs in their oral fluid or blood. Until 2011/2012, the detection rates between the proscribed drugs were relatively the same. In 2009/2010, SAPOL detected more drivers with cannabis in their system than any other drug. In the two year period from 1 July 2009 the detection rate for both cannabis and methylamphetamine was the same. During the 2011/2012 year a significant change in the detection rates between the drugs was observed.

Method

The driver drug testing regime introduced in South Australia established a 3 step process to determine the presence of a proscribed drug primarily using oral fluid. The process included:

- A screening test
- An oral fluid analysis or blood test
- A laboratory confirmation.

Utilising oral fluid, the equipment used to conduct a screening test is a Drugwipe Twin II manufactured by Securetec Detektion-Systeme AG in Germany. The screening test occurs whilst the driver remains seated in the vehicle (through the car window). If the driver returns a negative test they are free to go with all positive drivers being required to exit their vehicle to undergo a second stage screening test (oral fluid analysis) in either a police vehicle at the roadside or at a police station. The equipment to conduct an oral fluid analysis is a Cozart Drug Detection System (DDS) manufactured by Concateno in the United Kingdom.

At the conclusion of the screening process, all positive samples are sent to a forensic laboratory for confirmation of the presence of a proscribed drug.

The regime established in South Australia was initially established under a centralised model. In 2008, the model was decentralised across all traffic enforcement officers. The decentralised model operates with a full time driver drug testing group of 13 members undertaking 12,000 drug tests of drivers a year. In addition to these members operating full time, other traffic enforcement members across the jurisdiction undertake driver drug testing duties on an ad hoc basis, undertaking an additional 28,000 tests. In 2011/2012 there were 615 officers trained to conduct a drug screening test and of those trained, 328 officers are further trained to undertake oral fluid analyses.

2012 was the fourth year of the decentralised testing model established in South Australia.

Results

2011/2012 saw a significant change in the detection rates between the various drugs detected as highlighted in Figure One. In the 12 month period since 2010/2011 the level of detection for methylamphetamine increased by 108% to 5.2% of all driver screenings. This observation is significant whereby the previous trend of detections of the drug over 4 years was an increase by only 56%.

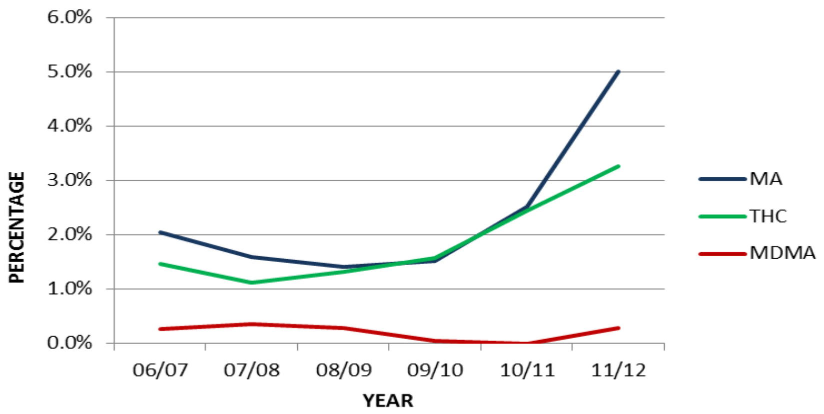

Figure One ***Proscribed Drug Driving Detection Rates in South Australia***

An analysis of the percentage of proscribed drugs of all positives detected (Figure Two) also shows the pronounced increase in the detection of methylamphetamine. Whilst the overall volume of all drugs detected has increased (Figure One), Figure two highlights the significant decrease in the percentage of cannabis being detected in 2011/2012 from all positive samples.

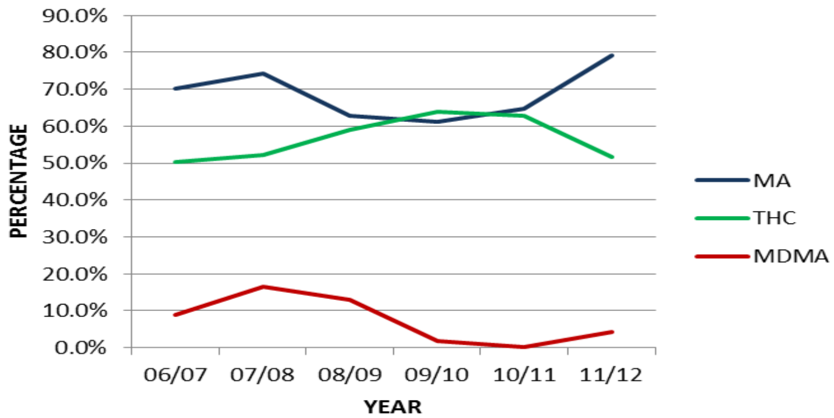

Figure Two ***Percentage of Proscribed Drugs of All Drug Driving Positives Detected***

During 2011/2012 the detection rate of methylamphetamine had increased by 14.6% compared to the previous year and the detection rate to cannabis had decreased by 11%. Of note was the emergence to ecstasy in the same period which had not been detected in drivers in South Australia for nearly 3 years.

The percentage of poly drug use also increased across the combination of proscribed drug categories compared to the previous 12 months. This was predominantly seen due to the re-emergence of ecstasy, but a 10.6% increase was noted in the combination of methylamphetamine and THC compared to the previous year.

In 2011/2012, 1 in every 16 drivers tested for a proscribed drug was positive. SAPOL saw a 38% increase in the number of drivers detected with a proscribed drug compared to the previous year. This increase was on top of a 35% increase experienced the previous year.

Discussion

There is no conclusive evidence as to why the increase in methylamphetamine and decrease in THC detections are being observed in South Australia. It can be argued that with detection time frames of 24 hours for methylamphetamine compare to a detection time frame of only 5 hours for THC that these results should be expected. This has not been the case previously in South Australia where we have seen significant detections to THC. It is possible that the emergence of synthetic cannabinoids may be a contributing factor.

Another contributing factor is the rise in the availability of methylamphetamine in Australia generally. This is supported by findings released by the Australian Institute of Criminology (Macgregor & Payne 2011) where the increase in methylamphetamine has been noted in the Drug use Monitoring Program in Australia. This is more than likely the reason for the change in trends of the type of amounts of drug being detected.

Overall, the increase in the detection rate of proscribed drugs in drivers in South Australia is attributed, not to the fact that more people are drug driving, but to the enforcement efforts being undertaken by SAPOL.

Conclusion

With a population base of 1.68 million people, SAPOL has been screening drivers for proscribed drugs per 100,000 population, approximately 4 times greater than any other Australian jurisdiction. That rate is set to increase with the number of drivers to be screened in South Australia during 2012/2013 increasing to 47,000 tests a year. The results achieved in South Australia can be described as nothing but a success. Over 230,000 drivers have now been screened for a proscribed drug with over 9,400 drivers confirmed positive.

The introduction of driver drug testing and the subsequent expansion which occurred in 2008 is helping to achieve goals set in the South Australia Police Road Safety Strategy 2011-2014 and the SA Road Safety Strategy 2020, Towards Zero Together.

Drivers who drive after the consumption of a proscribed drug are identified as dangerous drivers and SAPOL will continue to actively enforce this part of our legislation in an effort to help reduce road crashes.

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Involvement of alcohol and drugs in crashes with vulnerable road users in Canada

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Abstract

Background
As walking, cycling, and motorcycling gain in popularity, the onus is on road safety professionals to ensure that safety measures keep pace with the public interest in these activities. In order to effectively address the needs of pedestrians, cyclists, and motorcyclists in Canada, an epidemiological profile of injuries for such vulnerable road users is required to inform prevention initiatives.

Aims
The Traffic Injury Research Foundation (TIRF) has partnered with the Public Health Agency of Canada (PHAC) to conduct a comparative analysis of injuries relating to vulnerable road users. The primary goal is to present an up-to-date overview of crashes and injuries related to vulnerable road users in Canada. A second goal is to present an assessment of the role of alcohol and drugs in these crashes.

Methods
TIRF maintains two databases from which information was drawn. First, the National Fatality Database is a comprehensive, pan-Canadian, multi-decade set of core data related to all fatal motor vehicle crashes. Second, TIRF also maintains the Serious Injury Database, which contains information on persons seriously injured in crashes and on all drivers involved in these crashes. These data were compared with those available to PHAC including PHAC's own Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP), an injury surveillance system operating in the emergency departments of 11 paediatric and four general hospitals across Canada.

Results
Previous analyses have shown elevated instances of alcohol involvement among fatally injured pedestrians. Comparable results will be presented using the other data sources, both about alcohol as well as drug involvement.

Discussion and conclusions
While the evidence may be limited, it can be concluded that the involvement of alcohol and drugs in crashes with vulnerable road users must not be underestimated. The available data will be discussed with a special emphasis on informing prevention and mitigation initiatives.

Introduction

Protection for vulnerable road users on Canada's roads fails to match the level of protection quickly becoming standard for those driving motor vehicles. The vulnerability of pedestrians, cyclists and motorcyclists is exemplified by their overrepresentation in the total number of road user injuries and fatalities: According to the World Health Organization's most recent data, 46.0% of fatal road traffic injuries are sustained by vulnerable road users (WHO 2011).

Objectives

The goal of this paper is to investigate the injuries associated with vulnerable road users, and to gain a clear representation of the public health issue facing these road users, particularly as it is manifested in crashes and injuries on Canada's roadways. In addition, this paper seeks to investigate the role of alcohol and drugs in fatal vulnerable road user crashes.

Methods

To ascertain the extent of vulnerable road user fatalities and injuries in Canada, trends in the number of vulnerable road user fatalities and the share of vulnerable road user fatalities of all motor vehicle fatalities have been investigated. This involved the analyses of data on vulnerable road users contained in two databases managed by the Traffic Injury Research Foundation (TIRF); the Fatality Database and Serious Injury Database. The Fatality Database includes information on persons fatally injured in collisions in Canada from both coroners/medical examiners files and police collision reports. The Serious Injury Database includes information on seriously injured persons in Canada and is based on police-reported data. Comparisons were made between vulnerable road user types and age and gender groups within these user types to determine when collisions occurred and whether or not the vulnerable road users were under the influence of alcohol or drugs.

Data from the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) were also analyzed to ascertain the extent of vulnerable road user injuries in Canada. CHIRPP is an emergency department based injury surveillance system operated by the Public Health Agency of Canada, in which there are currently 11 paediatric and six general hospitals participating[1]. Since most of the data come from the paediatric hospitals, which are located in major cities, injuries among older teenagers and adults (who present with injuries at general hospitals), and people who live in rural and Northern areas including First Nations, Métis and Inuit people, are underrepresented. Fatal injuries are also underrepresented in CHIRPP because many victims who die at the scene are not transported to hospital. CHIRPP only records fatalities for victims who are dead on arrival or during treatment in the emergency department.

Three CHIRPP narrative (free text) fields allow a detailed level of classification and identification of very specific injury circumstances. Records of injuries sustained by vulnerable road users were identified using the code for CHIRPP's Injury Group variable, and an extensive bilingual (English and French) narrative-based search. Pedestrian and cyclist cases include those

[1] The data up to 2010 represent 15 hospitals.

involved in motor vehicle collisions (MVC) while motorcyclist cases include both MVC and non-MVC injury events that occurred on public roads.

Results

The authors analyzed trends according to victim type, among vulnerable road user fatalities in Canada between 1995 and 2010. According to TIRF's national Fatality Database, there were 757 vulnerable road users killed in 1995. Of this total, 493 were pedestrians, 174 were motorcyclists, and 90 were cyclists. In 2010, there were 631 vulnerable road user deaths in Canada. Of those, 358 were pedestrians, 196 were motorcyclists, and 77 were cyclists. Between 1995 and 2010, there has been a reduction in the number of pedestrians killed, the number of cyclists killed has remained relatively stable, and there has been a general increase in the number of motorcyclists killed.

In addition to absolute figures, percentages of each vulnerable road user type as a total of all road user fatalities from 1995 to 2010 were also calculated. In 1995, pedestrians comprised 13.4% of all motor vehicle fatalities, and this rose to 14.1% in 2010. During this same period, the share of fatalities among cyclists attributable to motor vehicle collisions rose slightly from 2.4% to 3.0%. Among motorcyclists, there was a more pronounced increase from 4.7% in 1995 to 7.7% in 2010.

With respect to gender, among all vulnerable road user types, males are at a higher risk of fatality or serious injury than females. Among fatally injured pedestrians, 62.9% were male, whereas 37.1% were female. Among seriously injured pedestrians, 56.4% were male, while 43.4% were female. The only exception was among seriously injured pedestrians aged 56 or over, where females outnumbered males. Further investigation shows that pedestrians aged 56 or older are more likely to be fatally or seriously injured than younger pedestrians. To illustrate, among pedestrian fatalities, 42.7% (2,978 of 6,978) were aged 56 or older. This was particularly true among women as 50.2% (1,303 of 2,591) of all pedestrian fatalities between 1995 and 2010 were aged 56 or older. Among seriously injured pedestrians, 24.8% (6,212 of 25,056) were aged 56 or older. An even higher proportion of seriously injured female pedestrians (30.3% or 3,294 of 10,880) were aged 56 or older.

The overrepresentation of males among fatally and seriously injured vulnerable road users is more pronounced among cyclists and motorcyclists. Among fatally injured cyclists between 1995 and 2010, 83.9% were males, and among seriously injured cyclists in the same time period, 76.1% were males. The greatest number of seriously injured cyclists (2,022 of 6,507 or 31.1%) was among those aged 0 to 15. Among the 4,949 seriously injured male cyclists, 1,503 (34.4%) were aged 0 to 15. And within the subset of 1,558 seriously injured female cyclists, 519 (33.3%) were from this age group.

Among motorcyclists who were fatally injured between 1995 and 2010, 89.8% were men while 10.2% were women. Among seriously injured motorcyclists, 83.8% were men compared to 16.2% who were women. Of the 3,016 fatally injured motorcyclists, 843 (28.0%) were aged 16-25. Motorcyclists from this age group also accounted for 782 (28.9%) of the 2,707 fatally injured males. Among the 309 fatally injured females, however, most were aged 46-55 (83 or 26.9%). Of the 17,119 seriously injured motorcyclists, 4,501 (26.3%) were aged 16-25. The proportion of 14,345 seriously injured male motorcyclists in this age group was even higher as 3,936 (or 27.4%) were aged 16-25. Among the 2,774 females, however, the greatest number of seriously injured motorcyclists (722 or 26.0%) was aged 36-45. Thus, female motorcycle crash victims who are seriously or fatally injured tend to be from an older age bracket than male motorcycle crash victims who are seriously or fatally injured.

Consistent with previous studies on the types of injuries commonly seen in vulnerable road users involved in crashes, the most common injury types among vulnerable road users between 1990 and 2010, according to CHIRPP data, are superficial injuries, fractures, and head injuries. Among cyclists and pedestrians, the most common type of trauma is the superficial injury (32.6% and 32.0%, respectively). Fractures (39.6%) represent the injury type most commonly found among motorcyclists.

With respect to alcohol use among road users, while the percentage of fatally injured drivers and motorcyclists testing positive for alcohol decreased from 1990 to 2000 and then stabilized throughout the beginning of the millennium, the same has not been true for fatally injured pedestrians and cyclists. Alcohol consumption by pedestrians remains a contributing factor in a large number of pedestrian fatalities, as 45.8% of fatally injured pedestrians had been drinking in 2010, a slight increase from 45.2% in 1990. The data for cyclists are less stable, since comparatively fewer Canadian cyclists are fatally injured in any given year, and because testing rates for cyclists (48.4%) tend to be lower than for motorcyclists (81.8%) and pedestrians (58.2%).

A more detailed investigation of alcohol consumption on the part of vulnerable road users is provided in Table 1. It reveals that, among fatally injured vulnerable road users, males are more likely than females to have consumed alcohol prior to the crash among all three victim types. This is particularly true among fatally injured male pedestrians where 45.9% had been drinking compared to 28.5% of fatally injured female pedestrians. Almost one-third of fatally injured male motorcyclists (32.2%) had been drinking compared to 17.9% of fatally injured female motorcyclists. Among fatally injured cyclists, 24.0% of males had been drinking compared to 7.1% of females. It should be noted that many of the fatally injured victims had consumed well over the legal limit of alcohol (which is a Blood Alcohol Concentration level or BAC of 0.08% in Canada). Among fatally injured vulnerable road users who had been drinking, 87.7% of pedestrians[2], 70.2%[3] of motorcyclists, and 70.6%[4] of cyclists had BACs over the legal limit. Furthermore, among fatally injured drinking pedestrians, 67.6%[5] had BACs over twice the legal limit between 2000 and 2010.

The extent to which drug use may contribute to vulnerable road user crashes in Canada was also investigated. Testing rates for drugs are low for fatally injured vulnerable road users - 37.0% overall, compared to a testing rate of 65.1% for alcohol. Among fatally injured vulnerable road

[2] [212+713] ÷ [2,616-1,561]*100
[3] [172+204] ÷ [1,700-1,164]*100
[4] [20+40] ÷[393-308]*100
[5] 713÷ [2,616-1,561]

users who were tested for the presence of drugs, 38.9% of pedestrians, 30.8% of cyclists, and 30.1% of motorcyclists tested positive.

The percentage of fatally injured road users who test positive for drugs between 2000 and 2010 was also investigated. It should be noted that these data are volatile, particularly with respect to cyclists who number fewer than the other road class users, and are tested for drugs less frequently. Between 2000 and 2010, the percentage of fatally injured pedestrians testing positive for drugs increased from 37.5% to 40.7%. In 2000, 36.7% of automobile drivers tested positive for drugs, compared to 36.8% in 2010. Motorcyclists have consistently been less likely to test positive than pedestrians and automobile drivers although there was an increase from 20.5% in 2000 to 29.2% in 2010. Cyclists have typically been the least likely to test positive for drugs. In 2000, none of the fatally injured tested cyclists were positive for drugs whereas 23.1% tested positive in 2010, which may reflect increase testing rates as opposed to an increase in actual drug use.

Victim Type	Number of Victims*	Victims Tested (% of total)	Victims Grouped by BAC (mg%) (% of tested)				
			Negative	1-49	50-80	81-160	>160
Pedestrians							
Males	2808	1781	964	49	48	166	554
		(63.4)	(54.1)	(2.8)	(2.7)	(9.3)	(31.1)
Females	1656	835	597	15	18	46	159
		(50.4)	(71.5)	(1.8)	(2.2)	(5.5)	(19.0)
All Pedestrians	4464	2616	1561	64	66	212	713
		(58.6)	(59.7)	(2.4)	(2.5)	(8.1)	(27.3)
Motorcyclists							
Males	1949	1622	1100	108	45	169	200
		(83.2)	(67.8)	(6.7)	(2.8)	(10.4)	(12.3)
Females	99	78	64	5	2	3	4
		(78.8)	(82.1)	(6.4)	(2.6)	(3.8)	(5.1)
All Motorcyclists	2048	1700	1164	113	47	172	204
		(83.0)	(68.5)	(6.6)	(2.8)	(10.1)	(12.0)
Cyclists							
Males	612	337	256	20	4	19	38
		(55.1)	(76.0)	(5.9)	(1.2)	(5.6)	(11.3)
Females	107	56	52	1	0	1	2
		(52.3)	(92.9)	(1.8)	(0.0)	(1.8)	(3.6)
All Cyclists	719	393	308	21	4	20	40
		(54.7)	(78.4)	(5.3)	(1.0)	(5.1)	(10.2)
ALL VULNERABLE ROAD USERS	7,231	4,709	3,033	198	117	404	957
		(65.1)	(64.4)	(4.2)	(2.5)	(8.6)	(20.3)

* Excludes passengers of motorcycles and bicycles.

Table 1: Alcohol use among fatally injured vulnerable road users by victim type and gender: Canada 2000-2010, TIRF fatality database

Discussion

A general downward trend in the absolute number of pedestrian fatalities from 1995 to 2010 has emerged; however no such downward trend is immediately apparent for cyclists and motorcyclists. Of note, while the number of pedestrians killed on Canada's roadways each year seems to be diminishing, the percentage of deaths among these victims as a percentage of all road user deaths does not show a similar decline. This suggests that while fewer Canadians overall are dying on the roadways, it is occupants of passenger vehicles who are benefiting the most from progress in road safety, and not vulnerable road users.

Furthermore, the data in this paper corroborate previous research from Canada and the United States, showing that child and teen cyclists are the most likely to suffer a serious or fatal injury, followed by cyclists aged 56 and older. Consistent with similar research, it was also found that motorcyclists aged 16-25 are overrepresented both in terms of serious injury and fatalities. Elderly pedestrians are overrepresented in both fatal and serious injury pedestrian crashes, with female pedestrians comprising a particularly high-risk group. As Canada's population ages, the need to ensure the safety of elderly vulnerable road users will no doubt receive greater priority (Robertson and Vanlaar, 2008, p.1983).

Alcohol and drug use among vulnerable road users has been a relatively neglected issue compared with alcohol and drug use among drivers of passenger vehicles. While the percentages of fatally injured drivers and motorcyclists that test positive for alcohol are decreasing, the same cannot be said for pedestrians. The percentage of fatally injured pedestrians who tested positive for alcohol consumption was almost exactly the same in 2010 (45.8%) as in 1990 (45.2%). Motorcyclists are the only group of vulnerable road users among whom it seems real progress in reducing drinking and driving has been made. With respect to statistics for cyclists, these data are volatile and trends over the 20-year time frame studied are not obvious. More data are needed before we can conclude that cyclist alcohol-involvement is similar to, or different from, that of pedestrians, motorcyclists, or drivers of passenger vehicles. Drug use among vulnerable road users is another area of road safety research that has been largely neglected. While testing rates are again generally low, between 30% and 40% of fatally injured vulnerable road users test positive for drugs.

Conclusion

The safety of vulnerable road users is an issue that is only increasing in importance. The promotion of walking and cycling as forms of exercise, growing popularity of motorcycling, overall population increases, as well as predicted increases in the number of elderly road users means that action must be taken to ensure that the proper measures are in place to protect these road users. Advances have been made in recent years, most notably with respect to drinking and driving among motorcyclists and the total number of annual pedestrian deaths, but safety gaps exist for vulnerable road users. The issue of drug- and alcohol-impaired pedestrians who are fatally wounded in crashes is of particular concern. This issue has received limited attention and few efforts have been made to inform pedestrians about the dangers inherent in this behaviour.

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Process evaluation of two remedial programs for alcohol-impaired drivers

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Abstract

Background
The Alberta Motor Association (AMA) administers and delivers the Alberta Impaired Drivers' Program (AIDP) under contract with Alberta Transportation. As such, it is responsible for the development, delivery, and oversight of two remedial programs for impaired drivers. The successful completion of these programs (Planning Ahead for first offenders and IMPACT for repeat offenders) is a condition of licence reinstatement for all drivers following an impaired driving conviction.

Aims
The Traffic Injury Research Foundation (TIRF) was contracted by AMA to undertake a process evaluation of both programs in 2011. The purpose of this evaluation is to identify what is currently working well within the AIDP and, more specifically, the Planning Ahead and IMPACT programs. Other goals of the evaluation are to examine program use and the effectiveness of operations, and to identify potential improvements.

Methods
The approach to answer all the research questions consists of a methodology based on the collection and synthesis of both qualitative and quantitative information. The manner in which this was achieved included focus groups, program observation, analysis of quantitative participant data and the use of a Delphi panel to inform the synthesis of all the data.

Results
Many strengths of the delivery and administration of the Planning Ahead and IMPACT programs have been identified. The adopted methodology has also provided insight into some areas where improvements can be made and ways that the program can be extended to better address the needs of its target population.

Discussion and conclusions
Recommendations based upon the outcomes of the process evaluation of Alberta's remedial programs will be discussed in detail. Some recommendations can also be useful to other jurisdictions that are considering a review, updates, or modifications to their remedial impaired driver programs.

Background

The Alberta Motor Association (AMA) administers and delivers the Alberta Impaired Drivers' Program (AIDP) under contract with Alberta Transportation. As such, it is responsible for the development, delivery, and oversight of two remedial programs for impaired drivers in the province. The successful completion of these programs (Planning Ahead for first offenders and IMPACT for repeat offenders) is a condition of licence reinstatement for all drivers following an impaired driving conviction.

TIRF was contracted by AMA to undertake a process evaluation of both impaired driver programs in 2011. The purpose of this evaluation is to identify what is currently working well within the AIDP and, more specifically, the Planning Ahead and IMPACT programs. Other goals of the evaluation are to examine program use and the effectiveness of operations, and to identify potential improvements.

The Planning Ahead program is a one-day psycho-educational course that is currently offered in 18 cities and towns across Alberta. The program is targeted toward first offenders and approximately 4,000 offenders participate in Planning Ahead each year. This represents a majority of the 4,600 individuals convicted for a first impaired driving offence in the province annually.

The main goal of Planning Ahead is to prevent impaired driving by preventing first offenders from becoming repeat offenders. The program is based on the belief that participants have the ability to change. This attitude is reinforced by reminding participants that they are capable of making smart choices and through the use of action plans, they can avoid impaired driving in the future. Other goals of Planning Ahead include teaching participants how to separate drinking and drug use from driving, the importance of zero tolerance for impaired driving, how lifestyles centered around alcohol and drugs lead to higher risk for impaired driving and how impairment affects driving abilities.

The IMPACT program, on the other hand, is targeted towards repeat offenders (i.e., offenders with two or more impaired driving convictions within ten years). This weekend residential course is delivered in Edmonton, Calgary, St. Albert, and Grand Prairie. Approximately 1,000 offenders participate in IMPACT each year and this represents a majority of the 1,400 repeat offenders that are convicted in Alberta on average each year.

The overall objectives of the program are to reduce alcohol and drug use among participants and to reduce subsequent involvement in alcohol and/or drugged driving offences or impaired driving recidivism. To accomplish these goals, IMPACT helps participants to recognize and understand how alcohol and/or drug use has affected their major life areas, assess the degree of problems that alcohol and/or drug use have caused, and make an action plan to deal with any of these problems.

Objectives

The overall objective of the process evaluation is to assess the operational effectiveness of Planning Ahead and IMPACT. A key area of focus is how each program operates and is delivered. More specifically, the goals of the process evaluation are:

- to determine the use of the programs (e.g. participation rates) and stakeholder's perceptions of the programs;
- to determine the operational effectiveness of Planning Ahead and IMPACT; and,
- to identify potential improvements to each program.

Methods

The methodology used to conduct the process evaluation is based on the collection and synthesis of both qualitative and quantitative information. The manner in which this was achieved included the following steps:

Observation of program delivery

A researcher observed the delivery of the Planning Ahead and IMPACT programs in their entirety. These observational data were used to generate discussion during the focus groups.

Conduct focus groups

A series of focus groups were organized to identify strengths, priority issues, and challenges related to program delivery, and to discuss potential solutions/improvements. Key staff from each of the geographic locations where the programs are offered were asked to participate in these focus groups (one for Planning Ahead and one for IMPACT), either in person or by phone. A third focus group with AIDP staff was also scheduled to gain their perspective about both programs.

Investigate conditions regarding availability and use of sensitive data

Given the potentially sensitive nature of the data needed for this evaluation (e.g., assessment summary reports), it was investigated in a privacy impact assessment if a privacy issue did exist. While no privacy issues were found, a determination was made that obtaining information from outside agencies would be too costly and time consuming. Therefore, it was agreed to use only the data contained in the AIDP database and that were immediately available.

Collect and analyze quantitative participant data

Quantitative information from participants was obtained from course record forms, course evaluations, and the AIDP database and analyzed.

Conduct Delphi panel

The data and information that were obtained in the previous four phases of the process evaluation were compiled and presented to stakeholders for feedback using a Delphi panel. This involved sending out a draft analysis of the results from the process evaluation (e.g., the observation of program delivery, the focus groups, and the data analysis) to a panel of stakeholders who reviewed it and provided their comments.

Write and finalize report

Finally, once sufficient understanding of all aspects of the program was reached based on the data collected during the process evaluation, the information was synthesized and evaluated with respect to the intended goals of the Planning Ahead and IMPACT programs.

Overall, the information obtained during the process evaluation was interpreted against a "system improvements" paradigm. “System” refers to the context in which strategies and countermeasures are implemented and delivered (e.g., goals of scheme, how participants are processed, levels of communication) and the structures or entities used to deliver these countermeasures to a designated target group (e.g., agency/stakeholder involvement in delivery, the legal system, treatment setting). The ability of each agency/stakeholder to perform their respective responsibilities and also effectively communicate with one another is key to the successful administration of programs such as Planning Ahead and IMPACT.

Results

An examination of the structure, content, and delivery of both the Planning Ahead and IMPACT programs led to several conclusions with respect to the effectiveness of the operation of these programs. What follows is a summary of the strengths and challenges of the programs evaluated and resulting recommendations for program improvements and extensions.

Strengths

Planning Ahead and IMPACT in particular, have rich and thorough curricula containing content that is continuously updated, relevant, and Alberta-specific. The structured and uniform delivery of this content across the province also guarantees that all participants receive the same information and that the course is delivered consistently. The main challenge is for course facilitators to deliver all course content while also allowing time for questions and engaging participants in dialogue about issues that they identify as relevant.

The preventive approach of the programs is also important. Participants are usually reluctant to attend because they view their participation as a punishment. Facilitators work to overcome these reservations and create a supportive and non-judgmental environment that facilitates rapport-building. By the end of the program, most participants note that they took away much more from the experience than they expected which encouraged subsequent lifestyle changes. Overall, participants are very satisfied with these programs.

The delivery of both Planning Ahead and IMPACT is efficient due in part to the clearly defined roles and responsibilities of AIDP staff and course facilitators. Each party understands the tasks that must be completed and executes them according to protocol. Open channels of dialogue between facilitators and AIDP, and the hiring of dedicated professionals have ensured effective and efficient program delivery.

Challenges

While the Planning Ahead and IMPACT programs have several strengths there are also some areas where improvements can be made. First, there is a need to ensure that all individuals who are required to participate in a remedial program register and complete the program. Failure to do so results in unlicensed driving.

Facilitators stated that they might benefit from additional information on the licence reinstatement process as they sometimes find themselves unable to provide answers to participants' questions. Facilitators agreed that they would like to have more information provided to them about impaired driving, treatment, driver licensing codes, ignition interlocks, driver abstracts (including those from other provinces) and services that are available in different communities.

Finally, investment in an automated data management system and improvement of data collection procedures are necessary, particularly if the number of program participants increases. An automated system can create efficiencies and improve tracking of participants and use of data to manage the programs. The implementation of an automated system would provide AIDP with an opportunity to better use the data that is collected from both remedial programs.

Recommendations

Resolving scheduling conflicts: There is a chance participants will not attend their scheduled program, resulting in cancelled courses which can be frustrating for facilitators who will lose time and revenue. In order to prevent a scheduling conflict, it may be beneficial to phone all participants a night in advance of their program in order to verify their attendance.

Continue to modify IMPACT and planning ahead curricula: AIDP is encouraged to continue to modify the curricula in accordance with new research and best practices. Facilitators should continue to be consulted prior to major updates so that they may offer suggestions and feedback. Participant comments should also be taken into consideration which can be collected through course evaluations.

Provide facilitators with more resources: More research materials should be made available to course facilitators, such as access to listserves and online journals with the latest research on impaired driving, treatment, and substance dependency which could be circulated by the AIDP Program Developer. Facilitators would also benefit from more information about the availability and quality of community resources, supports, and services in communities across the province.

Make more information available to program participants or potential participants: AMA can make program information more readily available so potential participants are aware of the programs and/or any remedial program requirements. The creation of a booklet, website, or brochure that explains the many requirements relating to licence reinstatement, remedial programs, and interlock requirements would be very helpful.

Improve data collection practices: Because data are important and essential to measure program successes and outcomes, it is recommended that AIDP staff determine what pieces of participant and program data should be collected in consultation with Alberta Transportation. Staff can review the information that is currently collected and entered into the existing system and identify any elements or variables that are missing.

Develop and implement an automated data management system: It is recommended that the AIDP consider the transition from a paper-based system to a fully automated data management system to improve the quality and efficiency of its services. Automation can reduce workload, increase information-sharing, and improve data management.

Identify opportunities for follow-up, relapse prevention, and/or treatment: The inclusion of a follow-up survey, phone call, or meeting with facilitators or even an optional, more intensive treatment program could provide participants with ongoing interaction post-program to assist with identified substance dependency issues to gain control over their drinking. Ultimately, these participants may benefit from additional intervention and this may prove necessary in order to prevent future occurrences of impaired driving.

Offer alternate options for those identified as ‘Problem Participants’: Participants returning to the program multiple times is indicative of the fact that they are not learning from the experience as the offending behaviour has not changed. AMA may consider exploring other avenues or making referrals to more intensive treatment interventions when dealing with repeat participants.

Increase awareness about the planning ahead and IMPACT programs among stakeholders: It appears that stakeholders have limited understanding about the operation of the remedial programs. Providing information about program activities, outcomes, and successes can foster understanding about the important contribution that AMA makes in addressing the impaired driving issue in Alberta. One strategy to create awareness is to organize a meeting among stakeholders to provide updates and discuss broader impaired driving issues in the province.

Identify and implement ideal practices for remedial programs: AMA should utilize the opportunity to network with other jurisdictions, for example with regard to out-of-province offenders, in order to identify common program features as well as challenges that are frequently encountered and potentially update these best practices.

Conclusion

Overall, AMA’s remedial programs are efficient, staffed with dedicated professionals who work collaboratively toward common goals, and well received among the target population. AIDP can continue to modify and expand the program as need dictates and view the program as a success but also as a work in progress. Future goals can include the development of best practices and the extension of the IMPACT program to include an aftercare or follow-up component. The recommendations made from this process evaluation are not unique to only the Albertan remedial programs. These recommendations offer insight into methods for improvement of participation rates and program efficiency which can be applied to and implemented in other similar remedial programs in North America and internationally.

A new neuropsychological instrument measuring effects of age and drugs on fitness to drive: development, reliability, and validity of MedDrive

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Abstract

Background
Current guidelines underline the limitations of existing instruments to assess fitness to drive and the poor adaptability of batteries of neuropsychological tests in primary care settings.

Aims
To provide a free, reliable, transparent computer based instrument capable of detecting effects of age or drugs on visual processing and cognitive functions.

Methods
Relying on systematic reviews of neuropsychological tests and driving performances, we conceived four new computed tasks measuring: visual processing (Task1), movement attention shift (Task2), executive response, alerting and orientation gain (Task3), and spatial memory (Task4). We then planned five studies to test MedDrive's reliability and validity. Study-1 defined instructions and learning functions collecting data from 105 senior drivers attending an automobile club course. Study-2 assessed concurrent validity for detecting minor cognitive impairment (MCI) against useful field of view (UFOV) on 120 new senior drivers. Study-3 collected data from 200 healthy drivers aged 20-90 to model age related normal cognitive decline. Study-4 measured MedDrive's reliability having 21 healthy volunteers repeat tests five times. Study-5 tested MedDrive's responsiveness to alcohol in a randomised, double-blinded, placebo, crossover, dose-response validation trial including 20 young healthy volunteers.

Results
Instructions were well understood and accepted by all senior drivers. Measures of visual processing (Task1) showed better performances than the UFOV in detecting MCI (ROC 0.770 vs. 0.620; p=0.048). MedDrive was capable of explaining 43.4% of changes occurring with natural cognitive decline. In young healthy drivers, learning effects became negligible from the third session onwards for all tasks except for dual tasking (ICC=0.769). All measures except alerting and orientation gain were affected by blood alcohol concentrations. Finally, MedDrive was able to explain 29.3% of potential causes of swerving on the driving simulator.

Discussion and conclusions
MedDrive reveals improved performances compared to existing computed neuropsychological tasks. It shows promising results both for clinical and research purposes.

Introduction

Studying effects of drugs on driving performance remains challenging. Merging principles from neuroscience, cognitive psychology, and ergonomics provide a solid translation approach to study the complexity of multiple cognitive processes engaged during driving (Lees, Cosman, Lee, Fricke, & Rizzo, 2010; Parasuraman & Wilson, 2008). Computational neuroergonomics has shown promising results in its capacity to model cognitive functions and predict driving difficulties (Aksan et al., 2012; Liu, Wu, & Berman, 2011). This has now made it possible to translate results from computed tests, such as the useful field of view (UFOV) (Ball et al., 2006; Hoffman, McDowd, Atchley, & Dubinsky, 2005) or the attention network task (ANT) (Weaver, Bedard, McAuliffe, & Parkkari, 2009), to real-life situations that can be observed when driving (Lees, et al., 2010). Recent technological advances in home-computer processing time have opened the field of cognitive screening for effects of age or medication on driving in primary care settings. This has led us to develop a new instrument to detect effects of natural cognitive decline or drugs on cognition functions indispensable for driving.

Developing MedDrive

Conceptual framework

MedDrive is a software that was programmed on C++ for personal computers on either Windows or Mac OS. It includes four computed neuropsychological tasks. The first three tasks were inspired from the UFOV, and the ANT. The UFOV has been shown to be one of the best predictors of driving difficulties. It is however designed for senior drivers and is not adapted to be used with younger drivers.(George & Crotty, 2010; Hoffman, et al., 2005; Mathias & Lucas, 2009; Silva, Laks, & Engelhardt, 2009) Using Posner's model of attention,(Jennings, Dagenbach, Engle, & Funke, 2007; Lopez-Ramon, Castro, Roca, Ledesma, & Lupianez, 2011; Posner & Rothbart, 2007) the ANT has been shown to measure different dimensions of attention than the UFOV (Weaver, et al., 2009). The ANT uses a single stimulus to measure simultaneously top-down arousal related to alertness or orientation, and frontal executional modulation related to coherent or incoherent visual information. We have however decided to separate these measures as it has been shown that they tend to interact one with another.(Fan, McCandliss, Sommer, Raz, & Posner, 2002; Macleod et al., 2010; McConnell & Shore, 2011) This has made it possible to improve the design of the paradigm and integrate movement detection instead of shape discrimination. The fourth task investigates spatial working memory (Olivers, Peters, Houtkamp, & Roelfsema, 2011; Ruchkin, Grafman, Cameron, & Berndt, 2003) MedDrive therefore combines visual processing, attention, executive functions, and working memory that have all been recognised as essential for driving (AMA/NHTSA, 2003; Bula, Eyer, von Gunten, Favrat, & Monod, 2011; Iverson et al., 2010; Messinger-Rapport, 2003; Mosimann et al., 2012; Murden & Unroe, 2005; Odenheimer, 2006; Sherman, 2006).

Calibrating tasks and formulating instructions

For visual processing (Task 1), images were exposed 500 times at 50ms and then modified until the prevalence of errors was equivalent for all image types. To achieve this, 8,500 exposures were needed. To measure the psychometric function of visual processing separately for each image type, three healthy young volunteers repeated measures 500 times for each of the following duration of exposure; 217ms, 150ms, 117ms, 83ms, 67ms, 50ms, 33ms, 17ms. Learning effects were diminished by having each volunteer run tests at least 10 times before measures were taken into consideration.

Instructions for each task were modified and tested on 106 senior drivers attending a course organised by the Swiss Automobile Association. During this phase, the arrows in the peripheral visual perception task were adapted to this population and increased in size. The final standardised version of instructions was used on 109 senior drivers. Participants were all able to perform tasks, even for those with mild cognitive impairment. The average time required to do all four tasks was of approximately 45 min with the instructions. In research settings, MedDrive requires 16’33’’.

Parallel forms

When driving, the localisation of an important visual stimulus is discovered at the same time as it appears. It therefore seemed important to test the effect of using randomised sequences of central, peripheral or dual images in the visual processing task (Task 1). In young healthy drivers, using random sequences increased the threshold for central vision processing by 24.6%, peripheral vision processing by 165.7%, and dual tasking by 22.8%. Nevertheless, the association to blood alcohol concentrations (BAC) and central processing threshold was twice better when tasks were not at random (R^2= 0.133 vs. R^2=0.067). However, using random mode made the task more sensitive in detecting effects with a BAC at 0.5g/L. On the other hand, central visual processing alone showed a better association to standard deviation of lateral position (SDLP) on the driving simulator without the random mode (R^2= 0.162 vs. R^2=0.040).

Orientation and alerting gain (Task 3) were subject to learning bias as the lapse of time between the exposure of the alerting or orientation cue and the response cue was constant. We therefore compared results after implementing a random lapse between both cues. The task’s performance in measuring orientation gain was thereby improved.

MedDrive’s reliability and validity

Reliability

Reliability was assessed by having 21 healthy participants (9 male, 11 female) repeat all tasks five times. Participant’s age ranged from 23 to 39 years (median of 25 years). The first measures were done on a PC with a 22-inch LCD screen. All other measures were done on participants’ personal computers. Reliability ranged from ICC=0.376 for central visual processing threshold (Task1) to ICC=0.818 for movement attention shift (Task2). This is partially explained by the fact learning effects were important for tasks related to visual processing. For all other tasks, learning effects become negligible after the second measure.

Concurrent validity

We tested 109 drivers of which 35 had a Monreal Cognitive Assessement (MoCA) score <26 points considered as minor cognitive impairement. MedDrive’s central visual processing (AUC=0.770) was significantly better at detecting those with mild cognitive impairment (p=0.048) than the UFOV (AUC=0.620). Furthermore, when modelling age in 61 healthy drivers, MedDrive was capable of explaining 43.4% of observed variance due to natural cognitive decline.

The benefit of MedDrive over the UFOV was even more evident when modelling performances on the driving simulator. SDLP was measured for 20 young healthy drivers who were not under the influence of any substances. MedDrive was able to explain 29.3% of observed variance of SDLP whereas UFOV only explained 0.5% thereby largely improving our ability to assess fitness drive in younger populations (p=0.003).

Responsiveness to alcohol

We organised a randomised, double blind, placebo, crossover, dose-response validation trial including 20 young healthy drivers (NCT01781273). Participants were given 1L of cranberry juice containing 96% ethanol to randomly bring their BAC to 0.0g/L, 0.5g/L, 0.65g/L or 0.8g/L. All tasks within MedDrive were affected by alcohol absorption. Central vision processing was affected from a BAC of 0.65g/L (+11.9%, p=0.002). In random mode, central visual processing was affected earlier (BAC=0.5 g/L; +6.9%, p=0.034). Movement detection and attention shift were affected with a BAC at 0.65 g/L (+10.3%, p=0.030), executive response time with a BAC at 0.8 g/L (+16.7%, p<0.001), and spatial memory with a BAC at 0.65 g/L (+15.6%, p=0.001).

Future perspectives

MedDrive reveals promising properties for both clinical and research purposes. Improvements in calculating thresholds in the visual processing task are under way to improve the task's reliability. Large cohort studies are needed to evaluate MedDrive's ability to predict risks of on road-accidents and improve age specific normative data. The software is already made available for research purposes at www.medDrive.org.

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Instruments for investigating fitness to drive – needs and expectations in primary care; a qualitative study

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Abstract

Background
Primary care physicians are often requested to assess their patients' fitness to drive. Little is however known on their needs to help them in this task.

Aims
The aim of this study is to develop theories on needs, expectations, and barriers for clinical instruments helping physicians assess fitness to drive in primary care.

Methods
This qualitative study used semi-structured interviews to investigate needs and expectations for instruments used to assess fitness to drive. From August 2011 to April 2013, we recorded opinions from five experts in traffic medicine, five primary care physicians, and five senior drivers. All interviews were integrally transcribed. Two independent researchers extracted, coded, and stratified categories relying on multi-grounded theory. All participants validated the final scheme.

Results
Our theory suggests that for an instruments assessing fitness to drive to be implemented in primary care, it need to contribute to the decisional process. This requires at least five conditions: 1) it needs to reduce the range of uncertainty, 2) it needs to be adapted to local resources and possibilities, 3) it needs to be accepted by patients, 4) choices of tasks need to adaptable to clinical conditions, 5) and interpretation of results need to remain dependant of each patient's context.

Discussion and conclusions
Most existing instruments assessing fitness to drive are not designed for primary care settings. Future instruments should also aim to support patient-centred dialogue, help anticipate driving cessation, and offer patients the opportunity to freely take their own decision on driving cessation as often as possible.

Introduction

On-road test is considered as a reference standard for assessing risks that drivers are taking when driving (Keall & Frith, 2004; Levy, Vernick, & Howard, 1995). For patients, such an assessment is often hard to accept. Physicians are therefore often solicited by patients, family, healthcare workers, or authorities to assess fitness to drive relying on medical status alone (Odenheimer, 2006). Furthermore, by moral and legal obligation, physicians are requested to inform their patients on consequences of their health condition on their fitness to drive. This requires them to be aware of potential effects of medication, aging, or other conditions on their driving performance. In day-to-day practice this can be difficult to achieve. Systematic reviews have shown the interest of neuropsychological tests in predicting driving difficulties (Carr & Ott, 2010; Martin, Marottoli, & O'Neill, 2009; Mathias & Lucas, 2009). Nevertheless, each task taken alone, these tests are not sufficiently valid to serve for screening proposes (Johansson et al., 1996). Combining tasks into a battery of tests seems promising to improve predictions for driving difficulties (Bedard, Weaver, Darzins, & Porter, 2008; Eby, Molnar, Nation, Shope, & Kostyniuk, 2006; Marottoli et al., 1998; McKenna, Jefferies, Dobson, & Frude, 2004). These are however often time consuming and are developed uniquely for dedicated centres. Actual guidelines therefore underline the lack of adapted instruments in primary care (Iverson et al., 2010) and the need to develop such instruments (Martin, et al., 2009). As a first step, it seems important to study needs, expectations and barriers for such instruments to be implemented in primary care.

Aims

The aim of this study is to develop theories on needs, expectations, and barriers for clinical instruments helping physicians assess fitness to drive in primary care.

Methods

Participants

We relied on data triangulation involving different sources of information to increase our study’s validity (Creswell & Miller, 2000). Even if saturation was to be observed earlier, at least 15 interviews were planned. A first group of five experts in traffic medicine, one psychologist, one neuropsychologist and three physicians were questioned. A second group of five primary care physicians were then interviewed individually. Finally, we collected the five senior drivers’ opinion. Each participant provided informed consent to participate. The study was approved by the official state ethical committee for biomedical studies (CE 157/11).

Data collection and transcription

Participants received oral and written information on the aims and objective of the study. At least 24 hours prior to the interview, they were told they would be questioned on their expectations regarding primary care assessment of fitness to drive, expectations from instruments used during this assessment, and the usefulness of collecting information on compensation strategies, driving history and cognitive state. We used 30 minutes semi-structured interviews to collect data. Questions were reformulated after each interview but before the next one. During the interview, participants were challenged to explain their position and opinions. Questions and directives helped them speak as much as possible of their own experience, and remain focused on the topic of interest. The audio files were made anonymous and were entirely transcribed to text by the second researcher. All analysis was done using Atelas.ti 7.

Empirical and theory driven analysis

We analysed interviews using multi-grounded theory. This approach made it possible to ground theories on empirical, theoretical, and internal grounding (Goldkuhl & Cronholm, 2010). Two independent researchers extracted fractions of text that appeared in relation to the studied theme. Inductive coding was then used to label each extracted item. Following each series of five interviews, both researchers combined their findings and discussed categorical structures until a consensus was met. This was done using conceptual refinement (critical reflexion, ontological determination, and linguistic determination). Evaluation of theoretical cohesion and theoretical matching were then used to validate categorical structures. After saturation was achieved, empirical validation was sought by having all participants give their approbation on the final categorical structure. We then constructed a table of frequency to describe origin of sources of empirical data and examine wether these were consistent across different sources of data.

Results

Interviews took place from August 2011 to April 2013. Saturation was achieved after the second interview in the third group (senior drivers). Results were sent to participants and their opinion regarding categorical structure was collected over the phone in Mai 2013.

Our theory suggests that for an instruments assessing fitness to drive to be implemented in primary care, it need to contribute to the decisional process. This requires at least five conditions: 1) it needs to reduce the range of uncertainty, 2) it needs to be adapted to local resources and possibilities, 3) it needs to be accepted by patients, 4) choices of tasks need to adaptable to clinical conditions, 5) and interpretation of results need to remain dependant of each patient’s context.

Reduce the range of uncertainty

An instrument is only useful for patients for which their fitness to drive is uncertain. In other words, physicians do not want to have to undergo batteries of task for those clearly unfit to drive, or for those for which their health condition clearly does not affect fitness to drive. Instruments should also help make sure all drivers respond to the same criteria and serve as a form of standardisation. As such, instruments can also serve to compensate lack of expertise or serve as a checklist. Experts, physicians, and patients to a lesser regard, considered important that the instrument included components that were validated and clearly related to driving performances. To help them in their decisional process, instrument should provide quantitative measures of abilities and make it possible for physician to classify patients in risk categories.

Local resources and possibilities

An instrument has more chance of been purchased by primary care physicians if it is easy to obtain, is adapted to local hardware without having to add too many accessories (limitation in space), and is reasonably cheap. Physicians are also more attracted by instruments that help them spare time. Finally, instruments need to conform to legal constraints regarding data protection.

Patient acceptance

Relying on instruments to assess fitness to drive makes it possible to depersonalise the decision regarding driving cessation. This offers the possibility to discuss the consequences of health conditions on driving performances rather than argue on the medical reasons why such a decision is to be taken. Overall, patients tend to trust their physician's opinion on their interpretation of clinical measures. However, when these are related to their driving performance, for which they have their own opinion, it seems important that they can understand and accept the link between these measures and their driving capacities.

Adaptability to clinical conditions

Physicians need an instrument they can adapt to their needs. Instruments can either be used for screening, to assess fitness related to a given medical condition, or can be used to monitor evolution towards remission or severity. In any case, physicians want to be able to limit their investigations to the fields were they are uncertain. In other words, it is important for operators to be able to decide which component of an instrument to use depending of the given context.

Contextualisation of results

When assessing fitness to drive, both primary care physicians and experts consider that interpretation of measures from an instrument need to be contextualised for each situation before providing a clear answer on driving cessation. Unplanned difficulties occurring during the measures, medical history, medication, addictions, driving history, physical condition, cognitive state, risks of loss of consciousness, family or friend's concern for driving difficulties, patient's capacity to recognise difficulties in specific circumstances and efficiently compensate them (e.g. stops driving at night, never drive under medication, uses public transports when feeling weary, etc.) are some examples that physicians need to account for. To form their opinion, they might also request complementary exams, or send patients to specialists for further investigations on their medical condition. As a last resource, they might also consider needing a psycho-medical expertise on fitness to drive or request the patient to undergo an official on-road test before forcing patient to hand their driver's license back.

Discussion and conclusion

Given the potential implication of driving cessation on their patients' quality of life, physicians need to feel certain of their decision before recommending driving cessation. This process is facilitated if patients understand and support such a decision. Instruments should therefore support patient-centred dialogue, help anticipate driving cessation, and offer patients the opportunity to freely take their own decision on driving cessation as often as possible.

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Impairment based legislative limits for driving under the influence of non-alcohol drugs: The Norwegian experience

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Abstract

Context
Driving under the influence of drugs (DUID) or alcohol represents an important risk factor for traffic accidents. For alcohol, Norway has since 1936 practiced impairment based legislation, with a legal limit presently at 0.02%. For drugs other than alcohol, an individual evaluation of impairment was previously made in each case. This system was time consuming and expensive, and has probably been practised in a more lenient fashion as compared to alcohol cases.

To harmonize the current practice for driving under the influence of alcohol and non-alcohol drugs, legislative limits were introduced for non-alcohol drugs in Norway from February 1st 2012.

Objectives
Presentation of the new legislative limits in Norway and status after about 1.5 years experience.

Key Outcomes
Impairment limits, representing drug concentrations in whole blood likely to be accompanied by a degree of impairment comparable to blood alcohol concentrations (BACs) of 0.02%, were established for 20 psychotropic drugs.

Limits for graded sanctions, representing drug concentrations in blood likely to induce impairment comparable to BACs of 0.05% and 0.12%, were defined for 13 of the 20 substances.

Such limits enable the court to meter out sanctions based solely on the measured drug concentrations, thus reducing the need for expert statements.

Discussion and conclusions
After introducing the new legislation, a slight increase in the number of DUID cases has been seen in Norway. The total number of cases in 2012 was about 8600 compared to about 7800 for the two previous years.

The number of expert statements has been reduced to almost half. Since the law does not state how impairment should be assessed when more than one drug is detected, and since seven of the substances, i.e. amphetamine and methamphetamine, do not have limits for graded sanctions, expert statements are still required.

There are presently no systematic data on how the new legislation has influenced court sentences in traffic cases. Our impression is that cases with analytical results without expert statements have been processed as intended by the Norwegian courts.

Introduction

Abuse of illicit or medicinal drugs constitute important risk factors for traffic accidents worldwide (Movig et al., 2004; Mura et al., 2003; Longo, Hunter, Lokan, White, & White, 2000; Drummer et al., 2004). In fatal traffic accidents in Norway in the period 2001-2010, alcohol and/or drugs of abuse were detected in 65 % of drivers killed in single vehicle accidents, and this number is even higher when examining younger drivers and accidents occurring at night time (Gjerde, Normann, Christophersen, Samuelsen, & Morland, 2011). Different initiatives may reduce these accidents, and reducing the prevalence of DUID is one such important factor.

Since 1936, Norway has practiced an impairment based law for driving under the influence of alcohol (Gjerde, Christophersen, Bjorneboe, Sakshaug, & Morland, 1990). The impairment limit for alcohol is now 0.02% and graded sanctions are given for higher blood alcohol concentrations (BACs), with limits corresponding to levels of 0.05 and 0.12%. This might be one of the reasons for the low frequency of alcohol impaired drivers in regular Norwegian traffic, which is presently at about 0.4 % (Gjerde et al., 2008).

Before February 1st, 2012, Norway had no such limits for non-alcohol drugs, and the judicial process required an expert witness statement to evaluate driver impairment and to compare the degree of impairment to corresponding BACs. The frequency of driving under the influence of non-alcohol drugs in regular traffic has been found to exceed the number of drivers inebriated by alcohol by a factor of 5 (Gjerde, Normann, Christophersen, & Morland, 2011). This has led to a large number of cases requiring expert statements and ensuing long case processing times, high costs and also probably lower sanction rates as compared to alcohol cases.

On February 1st 2012, impairment based legislative limits for non-alcohol drugs were introduced in Norway (Vindenes et al., 2011). The aims were to harmonize the current practice for alcohol and non-alcohol drugs, to simplify legal procedures and to denote that, as for alcohol, non-alcohol drugs and driving are not compatible.

DUID cases in Norway

The Division of Forensic Medicine and drug abuse at the Norwegian Institute of Public Health analyses all blood samples collected from drivers suspected for drugged driving from the entire country. The Norwegian population consists of about five million inhabitants, and about 8000 DUID cases are analysed annually. About 3000 of these cases are analyzed only for ethanol, and about 5000 are screened for a broad selection of legal and illegal psychoactive drugs, encompassing more than 40 different moieties. Blood samples are usually drawn within 1-2 hours after apprehension.

The legislative limits

Impairment limits corresponding to 0.02%

Impairment limits, representing drug concentrations in whole blood likely to be accompanied by a degree of impairment comparable to that accompanying a BAC of 0.02%, were established for 20 psychotropic drugs (See table 1).

The chosen drugs were among those most frequently detected substances in DUID cases in Norway between 2008-2010. All are psychoactive drugs with an abuse potential that might increase the risk of traffic accidents

Limits for graded sanctions, corresponding to 0.05 and 0.12%

Limits for graded sanctions, representing drug concentrations in blood likely to induce impairment comparable to BACs of 0.05% and 0.12%, were defined for 13 of the 20 substances (See table 1). Some drugs do not have limits for graded sanctions, because the relationship between a drug concentration and the risk of traffic accident/impairment is variable or unknown.

Drugs	**Impairment limit** **(in whole blood)**	**Limit for graded sanctions comparable to 0.05 % BAC** **(in whole blood)**	**Limit for graded sanctions comparable to 0.12 % BAC** **(in whole blood)**
	ng/ml / micromoles/L	**ng/ml / micromoles/L**	**ng/ml / micromoles/L**
Alprazolam	3 / 0.010	6 / 0.020	15 / 0.050
Clonazepam	1.3 / 0.004	3 / 0.010	8 / 0.025
Diazepam	57 / 0.200	143 / 0.500	342 / 1.200
Fenazepam	1.8 / 0.005	5 / 0.015	10 / 0.030
Flunitrazepam	1.6 / 0.005	3 / 0.010	8 / 0.025

Nitrazepam	17 / 0.060	42 / 0.150	98 / 0.350
Oxazepam	172 / 0.600	430 / 1.500	860 / 3.000
Zolpidem	31 / 0.100	77 / 0.250	184 / 0.600
Zopiclone	12 / 0.030	23 / 0.060	58 / 0.150
THC	1.3 / 0.004	3 / 0.010	9 / 0.030
Amphetamine	41 / 0.300	*	*
Cocaine	24 / 0.080	*	*
MDMA	48 / 0.250	*	*
Methamphetamine	45 / 0.300	*	*
GHB	10 300 / 100	30 900 / 300	123 600 / 1200
Ketamine	55 / 0.200	137 / 0.500	329 / 1.200
LSD	1 / 0.003	*	*
Buprenorphine	0.9 / 0.002	*	*
Methadone	25 / 0.080	*	*
Morphine	9 / 0.030	24 / 0.080	61 / 0.200

Table 1

*Substances with only impairment limit corresponding to 0.02%.

The scientific basis for the limits

The limits are based mainly on experimental studies of psychomotor and cognitive performance after single doses in drug naïve individuals (Vindenes et al., 2011). The experimental studies were retrieved after a comprehensive literature search undertaken in 2011, focusing on studies in which the drugs in question had been compared with alcohol. The system with individualised expert evaluations is continued for individuals with valid prescriptions of medicinal drugs.

Status regarding DUID cases in Norway from February 1th, 2012

Number of cases

The total number of cases where drivers have been apprehended suspected of impaired driving, has increased slightly after introducing the new legislation, compared to previous years. Compared to around 7800 cases both in 2010 and 2011, a total of around 8600 cases were analysed in 2012.

In contrast to this increase in analysed traffic cases, the number of requests for expert witness reports have been significantly reduced, with close to a 50% reduction in caseload from 2011 to 2012. After introducing the legislative limits, numerous cases have been prosecuted without an expert witness and based solely on the reported drug concentrations. In cases where one of the drug concentrations is higher than the limit for graded sanction corresponding to 0.12%, an expert witness will normally not conclude with a higher degree of impairment. The need for an expert statement in such cases is thus usually superfluous.

Drug findings

The annual drug “top ten lists” for drugs detected in blood samples from Norwegian drivers apprehended by the police for suspected DUID has not changed markedly after introduction of the new legislative limits. Alcohol is still the most frequent substance found in apprehended drivers, followed by clonazepam, THC, amphetamines and diazepam. The percent of cases where clonazepam was detected did however increase from 24% in 2011 to 38% in 2012. Only minor changes in the order of frequency of the detected non-alcohol drugs have been found the last 10 years.

A reduction of the cut-off level for clonazepam, compared to the cut off level applied previously, might be the reason for the higher number of clonazepam detections apparent after February 1st, 2012.

LSD and ketamine were included in the screening program for DUID cases for preventive reasons, and this led to the detection of LSD in two cases during 2012. LSD has never been found in blood samples from apprehended Norwegian drivers previously, and the frequency of LSD impaired driving is to our knowledge unknown.

As in previous years, the mean number of drugs found per driver is between 2 to 3 different substances. If one of the drug concentrations is present in a concentration higher than the limit for graded sanction corresponding to 0.12%, the case can be taken to court without an expert report. If all drugs are present in lower concentrations, expert statements are presently still required to assess the total impairment in relation to the limits for graded sanctions.

Conclusion

Introduction of legal limits for 20 non-alcohol drugs in DUID cases has been introduced in Norway. For 13 of these drugs, limits for graded sanctions have also been implemented. The new legislation attempts to denote that driving and drug use are not compatible, and the new system has reduced the need for expert reports in such cases. The number of apprehended drivers has increased slightly in 2012, and if this trend continues, indicating enhanced surveillance, this legislative change might make an important contribution to the reduction of impaired driving, and thus traffic accidents, in Norway. The most important factor in this respect would be a possible deterrent effect.

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Attention Deficit Hyperactivity Disorder, Alcohol, Drugs and Driving: Population-based Examination in a Canadian Sample

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Abstract

Aims

This study examines the relationships among substance use, ADHD, other psychiatric problems, and driving outcomes among a representative sample of adults from Ontario, Canada.

Methods

The Centre for Addictions and Mental Health Ontario Monitor is an ongoing repeated cross-sectional telephone survey of adults which includes validated measures of: ADHD; psychiatric distress; antisocial behaviour; substance use and problems; driving outcomes. This study presents weighted results (descriptive statistics and regressions) of year one data of a 3-year study.

Results

A total of 1999 Ontario residents were sampled, of which 70 (3.5%) screened positively for ADHD. A significantly greater percentage of those who screened positively for ADHD (8.0%) reported at least one crash in the past year compared with those who screened negatively for ADHD (3.3Sequential regression analysis found that age, antisocial personality screen and lifetime cannabis use predicted collisions, while ADHD positive screen, substance abuse positive screen and lifetime cocaine use did not.

Discussion and conclusions

This first population-based study in Canada showed no relationship between the ADHD screen and collisions when age, sex and kilometres driven are controlled for, while the antisocial personality screen and lifetime cannabis use were significant predictors. However, these analyses are based on self-report screeners, not psychiatric diagnoses and a small sample. Thus, these results should be viewed with caution.

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a complex neurodevelopmental disorder (Toplak et al., 2009). It has been identified as a risk factor for motor vehicle crashes. Meta-analyses have indicated relative risks for crash involvement ranging from 1.54 (CI 1.12, 2.13) (Vaa, Alvarez, & Hockey, 2003) to 1.88 (CI 1.42, 2.50) (Jerome, Segal, & Habinski, 2006). However, virtually all studies suffer from serious methodological problems related to sampling, choice of comparison groups, non-validated measures and statistics. Additionally, studies examining many outcomes tend to find few significant differences between ADHD and comparison samples; yet the articles focus on the few differences and generally ignore many non-differences.

Some studies of adults with ADHD have found higher alcohol and drug use and problems compared to control samples (Brassett-Harnett & Butler, 2007; Goodman, 2007; Kessler et al., 2006, Mannuzza & Klein, 2000; Secnik et al., 2005; Wolraich et al., 2005; Young et al., 2003). However, research examining ADHD and drinking driving behaviours have found mixed results. One important methodological challenge is the use of clinical samples (Vingilis, 1983). ADHD samples are primarily drawn from treatment facilities but only a small and biased proportion seeks. Thus, a population-based study can contribute to our understanding of ADHD and risky driving, although it is important to point out that large, population-based surveys rely on screening instruments and are limited by the measurements.

The purpose of this study is to explore the relationships among self-reported screening measures of ADHD, other psychiatric problems, substance use/abuse and driving-related outcomes of a representative sample of Ontario adults. This study is based on the first year survey sample of a 3-year study and thus is exploratory because of its small sample size.

Methods

The data are based on telephone interviews with 1999 respondents (effective response rate = 51%) from the 2011 cycle of the Centre for Addiction and Mental Health (CAMH) Monitor, an ongoing cross-sectional telephone survey of Ontario adults (ages 18 or older) using a stratified two-stage probability selection procedure occurring each quarter. The percentages reported are based on the weighted sample size and are considered representative for the population surveyed.

Measures

<u>ADHD measures</u>: **1)** *Adult ADHD Self-Report Scale-V1.1 (ASRS-V1.1)* was developed by Kessler and colleagues (2007) in conjunction with a revision of the World Health Organization (WHO) Composite Diagnostic Interview. ; **2)** *Previous ADHD diagnosis*: **3)** *ADHD Medication use*. <u>Psychiatric distress and medication use measures</u>: **1)** General Health Questionnaire (GHQ12) is a widely used, well validated screening instrument for current psychiatric distress, and captures depression/anxiety and problems with social functioning (Donath, 2001; Goldberg & Hillier, 1979; Hardy, Shapiro, Haynes, & Rick, 1999). Chronbach's α = .82; **2)** pain/anxiety/depression medication use. <u>Antisocial behaviour measure</u>: **1)** The Antisocial Personality Disorder (ASPD) scale from the Mini-International Neuropsychiatric Interview (MINI). <u>Substance use and abuse measures</u>: **1)** Lifetime cannabis and cocaine use; **2)** Alcohol Use Disorders Identification Test (AUDIT) is a validated screening instrument developed by the WHO, particularly to detect individuals at

the less severe end of the spectrum of alcohol problems (Newcombe, Humeniuk, & Ali, 2005; Saunders et al., 1993). Binge drinking (5+ drinks in same occasion in the past 12 months); 4**)** Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) is a screening instrument, with good validity and reliability (WHO ASSIST Working Group, 2002) designed to assess for users of specific substances, the risk of experiencing health and other problems (e.g. social, financial, legal, relationship) from their current pattern of use. <u>Driving-related problem behaviours</u>: **1)** in last 12 months driving after having two or more drinks in the previous hour; 2**)** in last 12 months driving after having used cannabis in previous hour; 3**)** in the past 12 months driven a vehicle in a street race; 4**)** crash involvement in past year among those who reported driving the past 12 months. <u>Socio-demographics</u>: **1)** sex; **2)** age (2006 Census categories); **3)** driving exposure (estimated km driven per week).

Results

Overall, 70 (3.47%, CI: 2.73, 4.40) of respondents screened positively for ADHD. Table 1 presents the variables associated with crash involvement. Age, ADHD positive screen, and substance use and abuse were the only variables significantly associated with at least one self-reported crash in past 12 months.

Table 1 Crash status by age, ADHD screener status, substance use and abuse variables

Variables		**Crashed**		**Not**		**P**
		N	%	N	%	
Age**	18-24	12	6.8	164	93.2	.004
	25-44	52	8.3	578	91.7	
	45-64	28	4.6	575	95.4	
	≥65	7	2.6	263	97.4	
ADHD screen	ADHD+ Status	8	13.6	51	86.4	.013
	ADHD non-status	92	5.7	1516	94.3	
ASPD screen	ASPD	*2	28.6	*5	71.4	.011
	Non-ASPD	97	5.9	1556	94.1	
Pain meds	Taken meds	36	9.5	343	90.5	.001
	Never	67	5.0	1268	95.0	
Anti-anxiety meds	Taken meds	18	14.9	103	85.1	.000
	Never	86	5.4	1515	94.6	
ASSIST	Moderate/High (4+)	10	11.5	77	88.5	.029
	Low (0-3)	94	5.8	1540	94.2	
AUDIT8	Yes (8+)	20	8.9	205	91.1	.062
	No (0-7)	83	5.7	1377	94.3	
Binge drinking	Every day to once or twice a	9	7.5	111	92.5	.062
	<Once/week	47	7.8	552	92.2	
	Never	33	4.7	662	95.3	
Lifetime used	Yes	63	8.8	656	91.2	.000
	No	42	4.2	956	95.8	
Lifetime used	Yes	17	14.7	99	85.3	.000
	No	87	5.4	1517	94.6	
Racing past yr	Racing	6	25.0	18	75.0	.000
	No Racing	98	5.8	1600	94.2	

***** Small cell size. **High missing values are due to skips in the survey. ** Missing data for variables ranged from 13.3% to 28.8%.

Table 2 provides the results of the sequential logistic regression. Examination of odds ratios showed that those who reported having used anti-anxiety medication in the past 12 months (OR=2.343, CI 1.160, 4.732), and pain medication in the past 12 months (OR=1.926, CI 1.180, 3.145).

Table 2 Sequential logistic regression for self-reported crash involvement in past 12 months

	β	S.E.	Wald	df	Sig.	Exp (β)
Constant	-2.758	.112	606.327	1	.000	.063
Block 1						
Age	-.484	.134	13.123	1	.000	.616
Male	.139	.232	.356	1	.551	1.149
Weekly Driving km	.000	.000	2.846	1	.092	1.000
Constant	-1.770	.346	26.159	1	.000	.170
Model X^2 =16.864, *df*=3, *p*=.001,-2 Log likelihood=625.515						
Hosmer and Lemeshow Test X^2=6.677, df=8, sig.=.572						
Block 2						
Age	-.479	.134	12.747	1	.000	.619
Male	.139	.232	.356	1	.550	1.149
Weekly Driving km	.000	.000	2.923	1	.087	1.000
ADHD+ Screen	.208	.527	.156	1	.693	1.231
Constant	-1.792	.351	26.056	1	.000	.167
Model X^2=17.012, *df*=4, *p*=.002,-2 Log likelihood=625.367						
Hosmer and Lemeshow Test X^2=9.692, *df*=8, sig.=.287						
Block 3						
Age	-.489	.135	13.033	1	.000	.613
Male	.095	.235	.164	1	.686	1.100
Weekly Driving km	.000	.000	3.336	1	.068	1.000
ADHD+ Screen	-.098	.588	.028	1	.868	.907
ASPD	2.010	.955	4.427	1	.035	7.464
Constant	-1.759	.353	24.878	1	.000	.172
Model X^2=20.469, *df*=5, *p*=.001,-2 Log likelihood=621.910						
Hosmer and Lemeshow Test X^2=9.042, *df*=8, sig.=.339						
Block 4						
Age	-.447	.144	9.647	1	.002	.640
Male	.072	.241	.088	1	.766	1.074
Weekly Driving km	.000	.000	2.723	1	.099	1.000
ADHD+ Screen	-.778	.638	1.486	1	.223	.459
ASPD	1.120	1.007	1.237	1	.266	3.066
Binge drinking	.160	.133	1.432	1	.231	1.173
Cannabis life+	.420	.260	2.605	1	.107	1.522
Cocaine life+	.591	.362	2.674	1	.102	1.806
Anxiety meds	.851	.359	5.634	1	.018	2.343
Pain meds	.656	.250	6.869	1	.009	1.926
Constant	-2.505	.432	33.687	1	.000	.082
Model X^2=44.566, *df*=10, *p*=.000,-2 Log likelihood=597.813						
Hosmer and Lemeshow Test X^2=10.636, *df*=8, sig.=.223						

Discussion

Some studies have found ADHD to be a significant risk factor for violations and crashes (Jerome et al., 2006; Vaa et al., 2003). Attention regulation and impulsivity, two key symptoms of ADHD, have been associated with self-reported violations (Wickens, Toplak, & Wiesenthal, 2008). The current results suggest that although a larger percent of those who screened positively for ADHD reported at least one crash as a driver in the past year compared with those who screened negatively, the regression analysis showed that when age, gender and driving exposure were controlled for, no relationship was found for ADHD screener status and crashes. Rather ASPD screener status and cannabis use were significant predictors, but the large CIs suggest a low level of precision for these estimates. These results are consistent with other studies that found externalizing disorders, such as ASPD, may partly or fully explain negative driving-related outcomes (Barkley & Cox, 2007; Fried et al., 2006; Thompson et al., 2007; Wymbs et al., 2013). However, future research with larger sample sizes needs to re-examine the relationships between the ADHD screener status and other variables and to disaggregate the attention and impulsivity questions from the ADHD screener to further examine these dimensions in relation to substance use and driving outcomes.

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Methods for investigating crash risk: Comparing case control with responsibility analysis

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Abstract

Context

The determination of the relative risk of a highway crash associated with alcohol and/or drug use is critical to policy development. There are two primary methods for establishing relative risk: *case control studies* where both crash and control data are collected (a relatively expensive process) and *responsibility analysis* that exploits existing crash databases by using nonresponsible drivers as an "induced exposure" control group (which is less expensive and therefore more feasible for examining the large number of substances that can impact driving behavior). Key to the accuracy of these studies is the precise determination of causality through an accurate identification of drivers responsible for crashes. Unfortunately, neither the case control nor the responsibility analysis procedure provides such an optimal estimate of causality. Case-control studies compare *all crash-involved drivers* with a non-crash exposure group. In the responsibility analysis procedure, a noncrash-driver control group is not available and the validity of the control group of crash-involved not responsible drivers depends upon the accuracy of the separation of culpable from nonculpable drivers.

Objectives

In this effort, we examine in detail how different criteria for the inclusion of crash cases influence the accuracy of relative risk (RR) estimates based on BAC. To do so, we apply responsibility analysis to data collected from a recent crash case-control study where data from matched non-crash involved control drivers was collected.

Key Outcomes

We found that the RR rate for single vehicle crash (all of whom are viewed as responsible) were higher than RR rate for drivers in multivehicle crashes some of whom were not fully responsible for their crashes. Finally, the RR rate for drivers judged to be not responsible in multivehicle crashes was below 1.

Discussion and Conclusions

Our data demonstrated that, as claimed in responsibility analysis, the non-responsible drivers were similar to matched non-crash drivers (e.g. a random sample of exposed drivers). We also found as expected that responsibility analysis yields higher RR estimates because the crash case group contains only responsible drivers in contrast to the case control method where the crash group includes non-responsible drivers.

Introduction

In determining the crash risk presented by various driver characteristics, it is clear that the principle interest should be focused on drivers who produce the errors that cause crashes rather than the drivers who are the victims of the errors. However, both case control and responsibility analysis have significant limitations for the estimation of the relative risk of *causing* a crash. The case-control studies do not separate out the not responsible drivers who did not contribute to causing the crash and as a result may under estimate the risk of being responsible for a crash. Responsibility analysis produces a control group only for multivehicle drivers. It does not produce a control group for single vehicle crash drivers, those drivers must be compared against the innocent drivers in multivehicle crashes. Since the BACs of drivers in single vehicle crashes have been shown to be higher than those in multivehicle crashes (Hurst, Harte, & Frith, 1994), using the control group created by not-responsible multivehicle crash drivers may overestimate the relative risk of BAC in crashes.

A unique opportunity to study these limitations was provided by data collected in a classical case-control study conducted in Virginia Beach, Virginia, between 2009 and 2011. Research teams monitored police crash reports, traveled to the crash sites and interviewed the involved drivers, and then a week later, returned to the crash site on the same day, at the same time of day, and interviewed two randomly selected control drivers. Applying responsibility analysis to the crashes collected in that case-control study allowed us to divide the crash cases into three groups: (a) single-vehicle crash drivers where the lone driver is deemed responsible—responsible single-vehicle crash (RSVC) drivers, and based on culpability analysis; (b) drivers responsible for a multivehicle crash—responsible multiple vehicle crash (RMVC) drivers, and (c) drivers involved in, but not responsible for, a multivehicle crash—not-responsible multiple vehicle crash (NRMVC) drivers. The case-control procedure provided two exposure control cases for each driver in each of the three crash groups. This created the opportunity to estimate more precisely relative risk based on the three responsibility categorizations because there are individually matched control drivers for each category of crash involved driver. Specifically, this study has four objectives based on combining case control and responsibility analysis to a crash risk data set:

- Determine the relative risk of being *responsible* for a single-vehicle crash;
- Determine the relative risk of being *responsible* for a multivehicle crash;
- Determine the extent to which the induced exposure method replicates the control data from the case-control method (If both represent a random sample of at-risk drivers, then comparing the not responsible crash groups with its comparison crash group will yield a relative risk of 1.); and
- Test the hypothesis that because case-control studies include not responsible drivers in their crash group, they will yield lower BAC relative-risk estimates than responsibility analysis.

Methods

Research strategy

The data set for this analysis was the records of 2,994 crash-involved drivers and 5,988 control drivers from the relative-risk study funded by the U.S. National Highway Traffic Safety Administration (NHTSA) conducted in Virginia Beach, Virginia, in 2010-2011. The six-page limit constrains our ability to adequately describe the scale of the effort required to mount the complex roadside survey involving the collection of both self-report information and chemical test data. A detailed description of the methodology appears elsewhere in the proceedings of this meeting. In brief, to be eligible for inclusion in this study, a crash had to be "reportable" to the police (e.g., a crash involving an injury, a fatality, or property damage over $1,500) and occur on a public road, but not on a freeway, and involve a private, noncommercial vehicle. Standby interview teams consisting of a data collector and a law enforcement officer responded to police crash reports 24 hours a day, 7 days in the week. The crash-involved drivers were assured that the survey was voluntary and that responses were confidential and would have no effect on the investigation. Procedures were developed for collection of data from crash-involved drivers who were injured or died and were transported to the hospital or morgue or arrested for a driving while intoxicated (DWI). Each team was also responsible for collecting control data on two drivers for each crash driver on the same day a week later. Control drivers were randomly selected from the traffic stream, at the same time of day, at the same location, moving in the same direction of travel, as each crash-involved driver. It should be noted that only the crash report, the blood alcohol concentration (BAC), and the age and gender of the drivers was used in this study.

Following a review to remove any indication of drug or alcohol use, official crash records were independently reviewed by two officers trained in crash investigation to rate the culpability of each driver involved in the crash. If the responsibility decision did not correspond between the two reviewers, a third review was made by a supervisor to resolve the disagreement. The final categorization of drivers in multivehicle crashes produced by this process is shown in Table 1. Based on those assignments, we created a dichotomous variable by assigning the "Not-Responsible or Contributory" group as control cases with all other categories assigned as "Responsible" drivers. All drivers in single-vehicle crashes were designated to be "Responsible."

Table 1: Results of the responsibility analysis of multivehicle crash-involved drivers

Not Responsible Nor Contributory	**1406**	**50.5%**
Contributory/Not Responsible	15	0.5%
Contributory	110	4.0%
Responsible/contributory	367	13.2%
Responsible	884	31.8%
Total responsible	**1376**	**49.5%**

Based on these responsibility assignments, the six classifications of drivers; three crash involved and three exposed to crashes shown in Table 2 can be derived. This presentation identifies two responsible driver crash groups—single-vehicle crash (RSVC) drivers and responsible multivehicle crash (RMVC) drivers and four control groups; the not responsible multivehicle crash (NRMVC) drivers and three exposure control groups: single-vehicle exposure (SVE), multivehicle exposure (MVE), and not responsible multivehicle exposure (NRMVE) from the matched case-control cases.

Table 2. Numbers of drivers in each of six classes based on combining responsibility and case-control methods

From the culpability analysis	Crash-involved drivers	Exposure control drivers
Single-vehicle crashes	RSVC N=212	SVE N= 424
Multivehicle responsible	RMVC N=1376	MVE N=2752
Multivehicle not responsible	NRMVC N=1406	NRMVE N=2812

Results

To determine the extent of the relationship between the NRMVC derived from the culpability analysis and the three CMVE groups derived from the case-control study, we used logistic regression analysis to test for differences related in two key independent variables: driver's age and gender. We found that there were significantly more males in the SVE controls than in the MVE controls and fewer males and more young drivers in the NRMVC control group than in the MVE control groups. Based on this finding, we included age and gender covariates in all our relative-risk calculations.

Because alcohol related crashes are more frequent at nighttime (Voas, Romano, & Peck, 2009), we compared (Table 3) the total number of crashes for all hours of the day with the number of crashes during the nighttime period (9 p.m. to 3 a.m.) for the three crash groups. The prevalence of RSVCs was three times higher (22% versus 7%) at nighttime than at daytime. RMVCs accounted for about 45% in both time periods. Table 4 presents the percentage of drivers in each group with positive BACs for all drivers and for drivers in nighttime crashes. It is clear that the percentage with positive BACs is much higher among single-vehicle crash drivers than among multivehicle crash drivers both overall and at nighttime. From 9 p.m. to 3 a.m., 55% of the single-vehicle crash drivers had positive BACs.

Table 3. Percentage of drivers overall and at night for each type of crash involvement

Group Type	24-hour total	Nighttime (9 p.m. – 3 a.m.)
Single vehicle	7%	22%
Multivehicle	46%	43%
Multivehicle not responsible	47%	35%

Table 4. Percentage of crashes involving drivers with positive BACs: crash versus control

Group type	% of BAC Positive Drivers	
	Crash	Control
All crashes		
Single vehicle	34.0%	5.4%
Multivehicle responsible	4.8%	2.8%
Multivehicle not responsible	1.6%	2.6%
Nighttime 9 p.m. to 3 a.m. crashes		
Single vehicle	54.9%	7.8%
Multivehicle responsible	24.1%	6.7%
Multivehicle not responsible	7.8%	8.2%

Figure 1 displays the BAC relative-risk curves for five crash measures based on the logistic regression: the three groups (RSVC, RMVC, and NRMVC) of crash-involved drivers paired with the their matched exposure controls, and the standard risk curves based on the culpability analysis method (RSVC+RMVC compared with NRMVC) and the case-control analysis method (RSVC+RMVC+NRMVC compared to all three exposure control groups). The confidence intervals for each of the five relative-risk curves provided in Table 5 indicate that the relative-risk crash groups (RSVC, RMVC, and NRMVC) are significantly different from each other, but the traditional case control and culpability analysis curves do not vary significantly. As shown, the relative-risk curves for the RSVC accelerates significantly faster than for any of the other crash groups, and the NRMVC group of nonculpable drivers displays a relative risk of 1 that does not vary with increasing BAC.

Table 5. Confidence intervals for the regression coefficients of the BAC relative-risk curves in Figure 1

Type	BAC point estimate	95% CI
RSVC	36.22	(22.55,49.90)
RMVC	15.45	(9.73,21.17)
NRMVC	-1.04	(-9.22,7.14)
Case-control analysis	16.79	(13.09,20.50)
Responsibility analysis	21.50	(14.59,28.42)

Conclusion

Figure 1 provides the results that respond to our four objectives. Regarding our first and second objectives, these results dramatize the difference between the single-vehicle and multivehicle culpable and nonculpable drivers. Clearly, the RSVC drivers had a much higher relative risk of crash involvement than RMVC drivers in this study. This is consistent with previous BAC case-control studies (Hurst, et al., 1994) in which single-vehicle crashes were shown to involve drivers with higher BAC relative risk than when all crash drivers are combined. However, studies such as that of Hurst did not separated from the multivehicle drivers the not responsible drivers as was done in this study. It is surprising then that there is such a large difference between the single-vehicle drivers and the multivehicle drivers in the present case. This large difference is likely related to two factors: (a) a larger proportion of the single-vehicle crashes captured in the study occurred at night when alcohol-related crashes are more frequent and (b) all the single-vehicle crash drivers are fully responsible, whereas 492 (Table 1) of the responsible multivehicle drivers shared responsibility with another driver. NHTSA estimates that half of all crashes are not reported to the police. It is probable that the proportion of single-vehicle crashes that go unreported in surveys is higher than the proportion of multivehicle crashes not reported because a single-vehicle crash with no injuries where the vehicle can be driven away is more likely to go unreported than in a multivehicle crash in which an operator must contend with other drivers. Because single-vehicle crashes that involve little or moderate damage are less likely to be reported, those that are reported are likely to be more serious. It is well established that the probability of alcohol involvement is greater in more serious crashes. This is consistent with the current results where 34% of single-vehicle drivers compared to 4.8% of the multivehicle drivers had positive BACs. Further evidence for the strong relationship of crash severity to single-vehicle crashes was obtained by examining the percentage of all fatal crashes that were single-vehicle crashes in NHTSA's Fatality Analysis Reporting System (FARS; NHTSA, 2010). In this study that included crashes of all levels of severity, single-vehicle crashes were 7% of the total; in FARS, which is a census of all fatal crashes, they comprised 42% of all fatal crashes. The steep slope of the single-vehicle crash relative-risk curve in Figure 1 probably reflects the more serious single-vehicle crashes that came to the attention of the researchers in Virginia Beach.

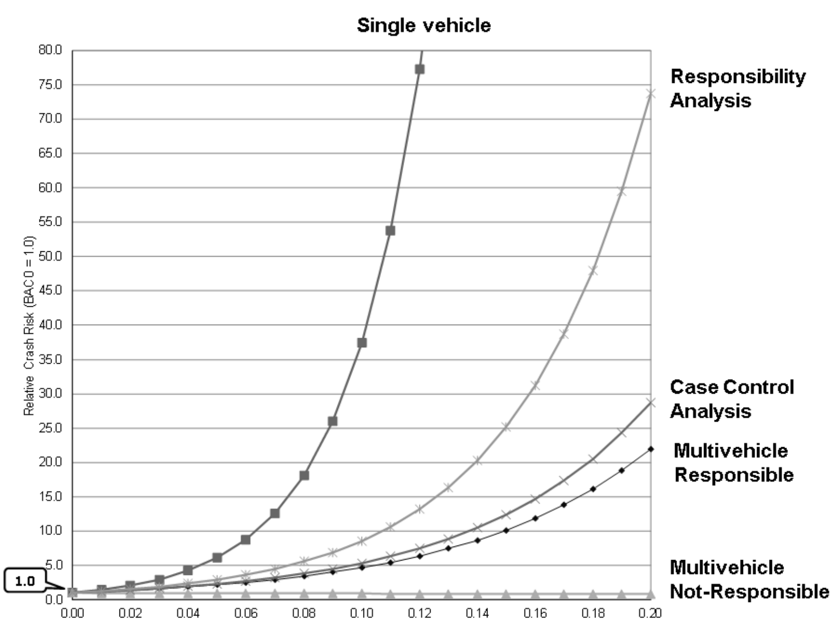

Figure 1. Alcohol relative-risk curves

Our third objective was to determine the extent to which the NRMVC-induced exposure group developed by culpability analysis was similar to the exposure groups produced by the case-control procedure. In our comparison of the NRMVC drivers with their matched exposure group (NRMVE), we found that the NRMVC drivers were more likely to be younger and female than the corresponding NRMVE drivers from the case-control study. As shown in Figure 1, however, when the relative risk of involvement in a crash is calculated for the NRMVC/NRMVE comparison using covariates for age and gender, the BAC relative risk is 1and falls is a straight line across the bottom of Figure 1. Thus, there appear to be no important differences between the induced-exposure group developed from culpability analysis and the exposure control groups generated by case-control studies.

Our final objective was to compare the BAC relative-risk curves generated by the standard analysis procedures used in culpability analysis compared to case-control analysis studies. We had predicted that because the culpability analysis method eliminates the not responsible drivers from the crash group that it would result in producing higher relative-risk curves than the case-control analysis method that includes the not responsible cases. The predicted difference appears very large in Figure 1; however, it is not statistically significant.

An important outcome from this analysis is the separation of the risk curves for *causing* a crash from the relative risk of being *involved* in a crash. Separate risk curves related to the causation of single- and multiple-vehicle crashes were contrasted, with the single-vehicle drivers showing a much greater rise in risk as a function of BAC. However, a substantial amount of the difference in the BAC relative-risk function in single and multiple vehicle crashes in this study may result from the difficulty in sampling single-vehicle crash drivers compared to multivehicle crash drivers. The isolation of the not responsible crash drivers allowed, for the first time, the development of a risk curve for becoming the “victim” of a crash. That curve appears to demonstrate, as has generally been assumed for culpability analysis, that “innocent” drivers provide a reasonable sample of the exposed drivers.

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Recidivism following interlock: Any evidence of change?

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Abstract

Background
There is extensive evidence that vehicle alcohol interlocks reduce impaired-driving recidivism by approximately two-thirds while on the offender's vehicle. However, the effectiveness of the interlock is substantially limited as most studies indicate that the benefit achieved while on the offender's car is not carried over to driving following interlock removal. The state of Florida's interlock program, which requires a period of license revocation before installing the interlock, offered an opportunity to study recidivism under three conditions: (a) during the license revocation period before entering the interlock program; (b) while on the interlock; and (c) during the post-interlock period when the offender's license was restored.

Aims
This study had two aims: (a) To determine factors associated with the reduction in recidivism for offenders moving from a revoked-license condition to driving an interlock-equipped vehicle, and (b) To determine the factors associated with the rise in recidivism for offenders after the removal of the interlock and the restoration of their license status.

Methods
Using Cox regression, interlock program records of 33,446 first-time, impaired-driving offenders in Florida were analyzed as they moved from license revocation to driving on an interlock to postinterlock status.

Results
While their licenses were revoked, the first offenders exhibited a 2.3% annual recidivism rate. Once they moved on to the interlock program, the annual recidivism rate dropped to 0.4%. In the 4 years following interlock removal, the recidivism rate returned to the 2% level. Offenders on interlocks whose time on the device was extended based on poor interlock performance had 4% annual recidivism rates.

Discussion and conclusions
The data suggest that the extent to which offenders' recidivism rates increase following interlock removal can be identified by variables available to program managers.

Background

Vehicle alcohol ignition interlocks provide convicted drinking drivers with an alternative to having their licenses suspended and being unable to drive legally. It would be expected that this alternative would be attractive to individuals convicted of driving while impaired (DWI). However, experience has shown that when provided with the opportunity by a state motor vehicle department to substitute time on the interlock for a full license suspension, only 10 to 20% of DWI offenders accept that opportunity. The reason for this resistance to the interlock is unclear, but apparently results from several factors: the relatively low risk of apprehension if driving illicitly without a license, the nuisance and annoyance of having to take a breath test every time the vehicle is started and every 15 minutes while it is moving, and the potential embarrassment of having to make such breath tests. Whatever the reason for offenders' reticence to install an interlock, it has resulted in stimulating government efforts to coerce offenders to install interlocks. One program that is being widely implemented in an effort to force offenders to install interlocks is to require it as a condition for reinstating the driver's license. In states like Florida, reinstatement is contingent upon serving a minimum of 6 months on the interlock.

Aims

This study focuses on the proportion of the first DWI offenders in Florida who install interlocks and their recidivism rate compared to those who do not attempt to qualify for reinstatement.

Methods

The Florida Department of Highway Safety and Motor Vehicles (DHSMV) has established an interlock data tracking program that captures the full driving record and interlock record of every individual required by state law to install an interlock as a prerequisite to restoring the driver's license. From that file covering the period from 2002 to present, we obtained 33,446 records of first DWI offenders entering the Florida interlock record system. Inclusion criteria included having no prior DWI offense and meeting the state requirements as an aggravated first offender; that is, having an arrest BAC$\geq$.15 or having a child passenger younger than age 14. Other first offenders are not subject to the interlock requirement in Florida.

From the driver record portion of the interlock record system, we obtained the date of arrest, date of conviction, the length of the license revocation period, prior DWI arrests, and any subsequent DWI convictions (recidivism), license status, and eligibility for reinstatement. From the interlock portion of the record, we obtained the length of the required period on the interlock, which for first offenders is a minimum of 6 months but additional time can be required by the court based on the seriousness of the offense (i.e., being involved in a crash). From that portion of the record, we also obtained the date of interlock installation, removal of the interlock, reason for removal, and the imposition of time extensions on the interlock based on interlock performance (three or more lockouts).

Based on their performance in the interlock program, we divided the 33,446 cases into the six categories shown in Table 1 for our recidivism analysis. The first two categories were offenders who recidivated while their licenses were revoked before becoming eligible to reinstate. Recidivism during that period terminated their first-offender status and extended their license revocations pending a new trial as second offenders. Category 1 included those who recidivated but eventually did installed interlocks. At the point where the file was frozen for this analysis, however, only 73% had achieved reinstatement because the remainder had either recidivated once more or dropped out, failed to complete the interlock program, or were still on the interlock. Category 2 included those who never installed an interlock or qualified for reinstatement.

Table 1. Six categories of offenders based on progress through the Florida administrative interlock program

Group Definition	Number	Installed	Reinstated
Recidivated during hard suspension			

Group Definition	Number	Installed	Reinstated
1. Eventually installed	463	100%	78%[1]
2. Never installed	245	0%	0%
Completed hard suspension			
3. Installed/extended	1,858	100%	77%[2]
4. Installed/dropouts	515	100%	0%
5. Installed/completed on time	11,964	100%	100%
6. Never installed	18,401	0%	0%
TOTAL	33,446	14,800	12,467

[1]22% recidivated again, failed to complete time on interlock or still on interlock as of December 31, 2013
[2]23% still on interlock as of December 31, 2013

In the last four categories were the first offenders who completed their mandated period of revocation (75% complete in 6 months) without incurring another DWI offense. At this point offenders have the option, if they have obtain a clean record (paid fines, attended education program), to install the interlock as a prerequisite to reinstating their licenses. Three of the four groups did so: category 3 offenders installed the interlock, but because they had three or more lockouts, their time on the interlock was extended beyond the required period (normally 6 months); category 4 offenders installed interlocks but dropped out before completing the mandated installation time; and category 5 offenders installed an interlock, served the required time in the interlock program, and deinstalled normally. Finally, category 6 offenders could not or chose not to try to qualify for reinstatement and did not install interlocks. Overall, only 44% (14,800) of the 33,446 first offenders in our study installed interlocks, and to the date of the closing of our analysis file, only 37% (12,467) had been fully reinstated.

Analysis

This categorization process provided six nonequivalent groups for comparing recidivism following completion of the revocation period. To compare these groups, we used Cox regression, which makes the best use of the time-based event data (recidivism) available for this study. Because the groups are nonequivalent, Cox regression was particularly appropriate for handling the demographic variations (age, sex, and ethnicity) between groups. Recidivism was computed beginning on the date that the offender completed the mandated period of license revocation and continuing up to 5 years, depending on when the case entered our data set. Cases were censored only at the end of the 5-year period or on the date our file was frozen for analysis (February 1, 2011); therefore, more than one recidivism event was included for some offenders.

Results

As noted, first DWI offenders are required to serve a minimum of 6 months of license revocation before becoming eligible for reinstatement and installation of an interlock; however, they must also have clean records (paid their fines, completed treatment) to obtain eligibility. We found that some required as long as 3 years to install interlocks; those delaying installation demonstrated higher recidivism rates. As shown in Table 1, 708 of the 33,446 first offenders in this study recidivated during the revocation period. The annual recidivism rate for those with 1 year or less on revocation was 2.3%, the rate for those with 2 years on revocation was 2.5%, and the rate for those with 3 years was 4.0%.

Figure 1 provides the results of the survival analyses for the six different outcome groups shown in Table 1. The figure provides cumulative (one minus survival) rates for up to 6 years following completion of license revocation. The cumulative recidivism curves fall into three groups, with categories 2 and 6 in which offenders never installed having significantly lower recidivism rates. Category 6 was significantly lower (Wald 431.53, *p* <.0001) than category 5, the offenders who installed and completed on time, who in turn, had significantly lower recidivism rates than the category 3 offenders who dropped out (Wald 12.23, *p*=.0005) or the offenders in categories 1 and 4.

The offenders in category 5 who installed and completed their interlock sentence normally and on time exhibited a 0.4% recidivism rate for the 6 months (0.0 to 0.5 years) they were on the interlock. After the unit was removed, their full license privileges were restored, following which they experienced a 2% recidivism rate for the following 4½ years.

Categories 2 and 6 offenders who never installed interlocks exhibited the lowest recidivism rates. Category 6 offenders who remained revoked during the 5-year study period had about a 0.4% annual recidivism rate throughout that time period. The category 2 offenders, who recidivated during their period of license revocation were ineligible to install interlocks and remained revoked, had an annual 1% recidivism rate.

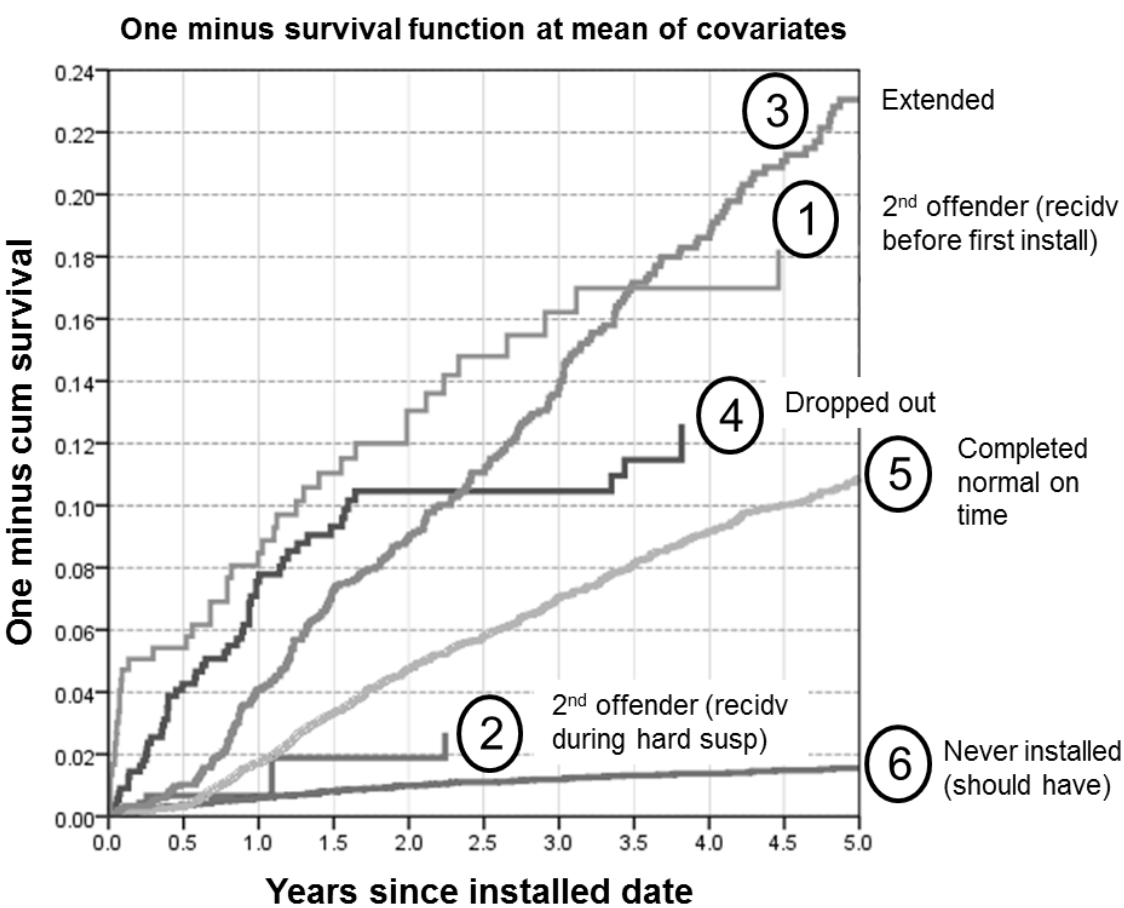

Figure 1. Recidivism from the end of the revocation period for six categories of offenders

As shown in Figure 1, offenders in category 3 whose time on the interlock was extended, but who, on completion of that additional obligation, had their full license privileges restored, exhibited approximately a 1% recidivism rate while on the interlock which when their interlock was removed and their full driving privileges were restored, rose to 4% per year, double that of the offenders who completed on time. Those offenders in category 4 who dropped out had a 6% annual recidivism rate over the first year and a half (partly because that was the basis for their inclusion in the dropout category). The later lower recidivism rate for that category reflects the relatively small numbers in the group. Finally, the offenders in categary1, who recidivated during their revocation period and, therefore, were barred from immediate installation of an interlock but did eventually install a unit exhibited approximately a 5% recidivism annual recidivism rate.

Discussion

These results provide new information on the application of the interlock programs to the license reinstatement process. The category 5 offenders who installed an interlock and completed the program on time received the intended interlock experience. For that category, Figure 1 shows the program had the typical result: minimal (0.4% annual recidivism while the unit was in place and a substantial rise (to 2% annual rate) following interlock deinstallation. New in this study is the following of the group for 4 years after interlock removal, which dramatizes the relatively short benefit period provided by the interlock and the failure of that experience to change long-term behavior. This suggests the need to supplement the interlock with education/treatment interventions.

The recidivism experience of category 3 offenders who had their time on the interlock extended because they failed to adequately control their interlock performance provides new information on the effectiveness of this policy. In this study, they exhibited twice (4%) the annual recidivism rate of those who completed on time. This clearly demonstrates that the criterions used to impose interlock extensions identify high-risk drivers and is consistent the results of the Marques, Tippetts, Voas, and Beirness (2001). It also suggests that extending the period on the interlock is appropriate, as it maintains low recidivism while in place. It also indicates, however, that the current additional monitoring and treatment programs imposed by the Florida DHSMV on those who have their time extended have an unfulfilled opportunity to further reduce the recidivism of those offenders.

The recidivism data on the offenders in category 4 provide unique information on users who drop out of interlock programs, as these offenders have not been previously studied. They clearly have higher recidivism rates than those who complete normally. Currently, the only action available to the Florida DHSMV is to cancel the interlock license and return them to the revocation status. Given the high rate of recidivism of dropouts, there is a need for a better understanding of the motivation of this group with an eye to developing an intervention program.

A significant barrier to the installation of an interlock is the occurrence of a recidivism event before qualifying for reinstatement. A unique feature of this study is the analysis of the driving records of such offenders (category 1) over a 5-year period. As shown in Table 1, two-thirds (463 of the 708 or 64%) of the first offenders who recidivated during their revocation period later returned as second offenders and installed interlocks, and 78% of those offenders qualified for reinstatement. During that transition, however, these second offenders exhibited the highest recidivism rates of any of those in this study.

From Table 1, we calculated that 32,738 of the 33,446 or 98% of the offenders in this study completed their mandated revocation period without recidivating. Of the 32,738 offenders, 18,401 (56%) did not install interlocks. The failure of convicted DWI offenders to reinstate their licenses is the norm. Voas, Tippetts, and McKnight (2010), in a study of six large states with small or no interlock programs, found that a third of multiple offenders and a quarter of first offenders did not reinstate their licenses within a 5-year period. The reasons for this have not been adequately studied, partly because it is difficult to determine from the driving record whether an individual is driving unless they receive traffic citations.

The surprising feature of the category 6 offenders who did not reinstate is the low (0.4%) recidivism rate that they maintained over the 5-year period of our study. Lacking adequate information on these offenders' motives and statuses, we are limited to speculation on the reasons for this low recidivism rate. There are undoubtedly those offenders who control their illicit driving so as to avoid repeat offenses. There are probably also those who simply cannot pay the fines, treatment fees, interlock costs, and increased insurance costs required to reinstate. Florida may be especially conducive to drivers with a low motivation to reinstate. Its substantial number of part-year resident "snowbirds" who opt to maintain vehicles registered in their home states and use public transport during their limited stays in Florida may be less motivated than are residents of other states to seek relicensing in Florida. Further, given the relatively warm weather conducive to bicycles and walking, more Florida offenders may simply give up driving.

This study has several limitations. It examines nonequivalent groups assembled based on post hoc information on outcomes including reinstatement decisions, interlock performance, and subsequent driving. We lacked information on the reasons for reinstating or the failure to reinstate and the extent to which the latter is coerced by circumstances or based on personal choice. We also lack information on the extent to which operators with revoked licenses are driving. Despite these limitations, this study sheds considerable light on the effectiveness of the administrative interlock programs tied to reinstatement. In the process, it identifies three important offender groups: (a) offenders who are either unable or unwilling to go to the trouble of reinstating, (b) offenders motivated to reinstate who install interlocks and perform within the program rules, and (c) offenders who are unable to adapt adequately to the interlock and despite the extension of their time on the interlock experience high recidivism rates following interlock removal.

Acknowledgment

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Relationship of binge drinking to illegal BACs among weekend nighttime drivers

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Abstract

In the United States the legal (blood alcohol concentration) BAC limit is .08 g/dL (grams per deciliter). This is the BAC generally produced by "binge drinking," defined by the U.S. National Institute on Alcohol Abuse and Alcoholism (NIAAA) as 4+ drinks for females and 5+ drinks for males. The objective of this study was to confirm this relationship by determining the percentage of drivers on U.S. roadways with illegal (≥.08 g/dL) BACs who report binge drinking. The prevalence of binge drinkers among a national sample of nighttime weekend drivers in the United States was determined through roadside interviews with a stratified random sample of 5,983 noncommercial drivers at 60 primary sampling locations in the 48 contiguous states on Fridays and Saturdays between 10 p.m. and 3 a.m. Forty-nine percent of the nighttime drivers who reported using alcohol also reported binge drinking on at least one occasion in the last year. They accounted for three-quarters of all the drivers with illegal BACs. Binge drinkers were four and a half times more likely to have an illegal BAC than nonbinge drinkers. The results indicate that among weekend nighttime drivers who drink, binge drinking is normative and strongly related to having an illegal BAC.

Aims

An opportunity to extend this information collected through telephone surveys to drivers on the roadways was provided by the 2007 National Roadside Survey (NRS), which collected BAC data and self-reports of binge drinking from a stratified random sample of 5,983 weekend, nighttime drivers in the 48 contiguous states (Lacey et al., 2011). These NRS data provided the first basis for directly relating self-reports of the prior year's binge drinking to the BACs of vehicle operators while driving. This study has two principal aims: (a) to describe the relationship of reported binge drinking and driver BAC and (b) to explore the factors related to having an illegal BAC while driving.

Background

Although consumption of alcohol in any amount can be hazardous for some individuals, it requires relatively heavy consumption to place a driver at a substantially elevated risk of a crash compared to being at a zero BAC. Binge drinking—generally defined as five or more drinks for males and four or more drinks for females on one occasion—is the consumption level associated with reaching the illegal limit of .08 g/dL (NIAAA, 2004) at which the relative risk of crashing is 2.69 times that of a sober driver (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2009).

There is evidence that binge drinking is prevalent in the United States and that there is a strong relationship between binge drinking and impaired driving. Naimi, Nelson, and Brewer (2009), based on data from the 2003-2004 Behavioral Risk Survey, reported that 11.9% of individuals who reported binge drinking (five or more drinks on one occasion at least once a month) indicated that they had driven within 2 hours of a binge-drinking episode. Flowers et al. (2008) estimated that monthly or more frequent binge drinkers accounted for 88.6% of all impaired-driving episodes).

Methods

The 2007 NRS sampling plan and data-collection procedures are described in detail in Lacey et al. (2011). In brief, the survey was designed to cover the 48 contiguous states with 60 primary sampling units derived from NHTSA's National Automotive Sampling System/General Estimates System. Police departments were recruited to provide support for the survey, and survey locations were selected by placing a 1-mile grid over the area patrolled by the police department and randomly selecting a square mile area that contained safe off-road areas in which the survey could be conducted. At the selected locations, officers directed drivers into safe off-road parking areas for the interview. Surveys were conducted during 2-hour daytime periods from 9 to 11 a.m. and 1 to 3 p.m. on Fridays, and during the nighttime periods from 10 p.m. to midnight and 1 to 3 a.m. on Fridays and Saturdays. Data from the daytime-collection periods on Fridays are not included in this study.

As a vehicle moved into the bay and during the initial contact with the driver, the interviewer recorded observations of the driver's age (within specified ranges), gender, ethnicity, and race. On initial contact, the interviewers assured motorists that they had done nothing wrong and that they had been randomly selected for participation in an anonymous, voluntary survey in which they could earn up to $65. Once the participant gave oral consent for the survey and provided a breath test, the interviewer proceeded with a set of 22 questions covering topics such as annual mileage, the origin and destination of the current trip, drinking, drinking and driving, and demographics. The participants were then invited to provide an oral fluid sample for drugs that required holding the collection device under their tongues for 3 to 5 minutes. While providing that sample, participants were asked to fill out the AUDIT questionnaire covering alcohol use disorders. After this phase of the survey was completed, the participants were offered an opportunity to provide a blood sample for a $50 incentive. Oral fluid and blood data are not included in this analysis.

Response rate

During the nighttime surveys, 8,537 drivers entered the interview site of which 8,384 were eligible for the survey. Drivers aged 16 and younger and commercial drivers were not eligible. Of these, 7,159 (85.45%) were breath tested. The AUDIT survey containing the binge-drinking question was limited to "current drinkers," reducing the participants available for this study to 5,983 (71.4% of the 8,384 eligible drivers) who reported consuming alcohol at least once in the last 12 months.

Measures

From the very large data set available from the 2007 NRS, only the breath-test results and answers to a limited set of questions covering demographics, driver records, binge drinking, trip characteristics, and BACs were analyzed for this study:

- *Demographics*. In addition to recording gender, which was observed, participants were asked to report on age, employment status, educational attainment, and ethnicity.
- *Driver record* information included whether the participant had ever been a driver in a nighttime crash; ever been arrested because of their drinking; and in the past 12 months, had ever driven after drinking enough to be considered legally under the influence of alcohol.
- *Binge drinking* was measured through the administration of the 10-item Alcohol Use Disorders Identification Test (AUDIT; Babor, Biddle-Higgins, Saunders, & Monteiro, 2001). Question 3 in the AUDIT; "In the past year, how often did you have 6 (5 for women) or more drinks on one occasion?" had five response categories: never, less than monthly, monthly, weekly, and daily/almost daily was used to measure the extent of binge drinking.
- *Trip characteristics* were assessed through questions covering the percentage of total driving done at night and trip origin (bar, restaurant, friend's home, their home, or other). In addition, the interview periods (early: 10 p.m. to midnight; late: 1 to 3 a.m.) were included in the study.
- *Driver BAC*. The CMI, Inc., Intoxilyzer 400™ (Owensboro, Kentucky) was used to collect the BAC of the participating drivers.

Data analysis

In our analysis, we applied logistic regression to explore the role of demographics, driving record, and survey time on the presence of an illegal BAC≥.08 g/dL in the participating driver. The analysis was conducted using SAS statistical software (version 9.1; SAS Institute, Cary, North Carolina) and STATA 11 statistical software (StataCorp LP, College Station, Texas). The STATA procedure "svy" was used to accommodate the NRS sampling design.

Results

Most of the participating drivers (85.57%) had zero BACs while 11.59% had positive BACs below .08 and 2.97% had BACs over the .08 illegal limit .Overall, 47.53% of the men and 61.99% of the women reported never having binged in the last year. However, those nonbinging percentages dropped to 20.11% and 26.70%, respectively, among drivers with .08 BACs indicating that 80% of the males and 73% of the females with illegal BACs reported binge drinking at least once in the last year. Overall 49% of all drivers who reported consuming alcohol in the last year reported binge drinking.

Table 1 provides the results of the logistic regression analysis of the relationship of driver demographics, driver record, survey time, and reported binge drinking to having a BAC ≥.08 g/dL at the roadside. Women were less likely than men and adults were four to six times more likely than underage drivers to have a BAC ≥08 g/dL. There were no significant relationships between race/ethnicity and having an illegal BAC. Drivers with some college education were less likely than those with only a high school diploma to have a ≥08 g/dL BACs. Employment status was not related to having an illegal BAC; however, those listing themselves as students were more likely to be binge drinkers. Drivers with illegal BACs were less likely to report that more than half of their driving occurred at night. However, drivers interviewed late at night (1 to 3 a.m.) were nearly six times more likely to have an illegal BAC than drivers interviewed earlier in the evening between 10 p.m. and midnight. Drivers coming from a bar or restaurant were more likely to have an illegal BAC. Having an illegal BAC was not related to a report of a prior nighttime crash, but was highly related to a report of a previous DWI arrest. Finally, binge drinkers were four and a half times more likely to have an illegal BAC than nonbinge drinkers.

Table 1. Relationship of driver demographics, driving record, and survey time to the probability that the driver would have a BAC of .08 or higher. Percentages are weighted; Ns are unweighted.

Participant Characteristics *(Total n= 4,670)*	**OR for BAC ≥.08**	**95% Confidence Interval**	
Gender			
Women (n=1,745)	0.658	0.483	0.895
Reference: Men (n=2,887)			
Age group			
21-34 years (n=2,190)	3.876	1.427	10.528
35-44 years (n=821)	4.405	1.540	12.601
45+ years (n=976)	5.859	1.938	17.717
Reference: <21 years (n=634)*			
Race/ethnicity			
Other (n=362)	1.369	0.501	3.741
Black or African American *(n=716)*	0.601	0.291	1.241
Hispanic *(n=779)*	0.906	0.589	1.393
Reference: White or Caucasian (n= 2,756*)*			
Education level			
Did not graduate HS (n=348)	0.688	0.346	1.371
Some college/college degree/some postgraduate/ postgraduate degree *(n= 3,176)*	0.695	0.485	0.997
Reference: HS graduate (n= 1,100)			
Employment status			
Student *(n= 416)*	1.639	1.005	2.674
Unemployed/retired/homemaker/on disability/other *(n= 829)*	1.539	0.656	3.615
Reference: employed/self-employed (n=3,794)			
Percent nighttime driving			
60-100% *(n=1,421)*	0.477	0.306	0.742
Reference: 0-40% of driving occurs during nighttime(n=3,204)			
Before/after midnight			
1 to 3 a.m. *(n=2,119)*	5.729	3.737	8.784
Reference: early evening to midnight (n=2,521)			
Trip Origin			
Bar, tavern, club, or restaurant *(n=719)*	1.699	1.059	2.726
Reference: all others (n=3,904)			
Previously involved in nighttime crash			
Involved in a nighttime crash previously *(n=594)*	0.554	0.318	0.967
Reference: no nighttime crash involvement (*n=4,029)*			
Previous arrests related to alcohol or drug use			
Previous arrest *(n=219)*	3.110	2.085	4.637

Participant Characteristics *(Total n= 4,670)*	OR for BAC ≥.08	95% Confidence Interval	
Reference: no previous arrest (n=3,988)			
Binge drinking			
Binge drinker *(n=703)*	4.674	2.761	7.915
Reference: nonbinge drinker *(n=3,512)*			

Discussion

Flowers et al. (2008) estimated that monthly or more frequent binge drinkers accounted for 88.6% of all impaired-driving episodes. In this study, we found that 72.82% of the monthly binge drinkers had BACs ≥.08 (the legal definition of impaired driving). As drivers can perceive that they have had too much to drink and can actually be impaired at BACs below .08, these two findings are reasonably congruent and support the significance of binge drinking to impaired driving.

This study suggests that binge drinking is normative behavior among individuals who consume alcohol and drive on weekend evenings (49.26% reported binge drinking in the last year). Police departments have traditionally taken advantage of this clustering of heavy drinkers on the roadways by mounting special, weekend night operations (such as dedicated patrols and sobriety checkpoints) to apprehend impaired drivers. During these operations, they typically stop many drivers who are under the illegal limit. These results suggest the potential value of such “nonproductive” stops if the interview with the officer produces a deterrent effect by alerting the potential offender to the level of impaired-driving enforcement. Checkpoints have been particularly hard to sell to police departments because, though many drivers are contacted, few are arrested, and the deterrence value, though substantial, is difficult to gage. Perhaps if officers understood that half of the individuals they interview are binge drinkers who are at substantial risk of impaired driving, enthusiasm for checkpoints might increase.

The Naimi et al. (2003) paper, based on a national sample, indicates that one in four Americans are binge drinkers. The evidence from this study, that binge drinking is associated with an illegal BAC, supports the potential importance of intervening with the 26.8% of Americans in the Naimi survey data report that they had a binge-drinking episode in the past year. In this study, the apparent willingness of individuals to report binge drinking (which is associated with being four and a half times more likely to have an illegal BAC while driving) and prior arrests (which are associated with being three times more likely to have an illegal BAC while driving) suggests that questions covering those two topics could provide good material for screening devices (Dill, Wells-Parker, & Soderstrom, 2004) for use in physicians’ offices, college health centers, and emergency rooms. The results of these screenings could indicate the need for a brief intervention, and the opportunity to provide one (Schermer, Moyers, Miller, & Bloomfield, 2006).

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Effects of untreated Rhinitis on actual driving. A patient study

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Abstract

Background. Allergic Rhinitis (AR), also known as Hay Fever, affects up to 30% of the adult population. While symptomatic, patients usually continue to engage in daily life activities, including car driving. Previous studies have shown that AR can impair cognitive functions, especially during longer lasting tasks and it has been identified as the cause of at least one fatal car accident. Treatment of AR is often done with drugs that might also induce somnolence and impair driving performance. This impairment is however exclusively based on studies with healthy volunteers. Not much is known on the (combined) effects of AR and drug treatment on driving performance of patients.
Aims. Primary objective was to determine the effect of AR per se on actual driving performance and compare it to the effects of AR treated with two types of drugs.
Methods. Nineteen patients with documented AR history engaged in a 1-hour on the road driving test outside the pollen season. In a 4-leg repeated measures design patients underwent a nasal provocation test with a pollen mixture to provoke AR symptoms or a placebo sham provocation. In the three conditions with pollen provocation patients were pre-treated with either cetirizine 10 mg, fluticasone furoate 27,5ug or placebo to alleviate the provoked AR symptoms.
Results. The driving performance of patients when symptomatic and not treated with medication was significantly impaired compared to their non-symptomatic performance in he placebo condition. When engaging in a secondary memory task during the driving task their performance deteriorated further and impairment was comparable to that seen at a blood alcohol level of 0.05%.
Conclusions. Untreated allergic rhinitis can seriously impair driving performance and put AR patients at increased risk, especially when engaging in other activities requiring attention during driving. Patients with AR should be cautioned that their condition can cause impairment.

Background

Allergic rhinitis (AR) is a very common condition, affecting between 15 – 30% of the general population with prevalence reported to be increasing over the last decades (Wallace et al. 2008). Untreated AR is associated with diminished productivity, discomfort, reduced functional ability and also reduced health-related quality of life (HRQOL, for an overview see Melzer , 2001). More specifically, the latter not only relates to psychological wellbeing but also to diminished cognitive functions such as memory and concentration (Kremer et al, 2002). Allergic Rhinitis or AR treatment is further also implicated in road safety and at least one report claims a direct relationship between AR and a lethal car accident (Spector, 2010). However, experimental studies on the effect of AR on driving are missing and long overdue (Smolensky 2011).
Besides AR itself also the treatment for alleviating symptoms can impair cognitive and psychomotor performance. Most of the first generation and some second-generation antihistamines cause sedation as a side effect and subsequently impair performance

(Vuurman et al 2004). This can be particularly relevant in safety related behavior, such as car driving or operating dangerous machinery. The impact of antihistamines on driving behavior has been shown in a series of studies employing a realistic on-the road driving test (O'Hanlon 1995). This model, that is also used in the present study, differs from most laboratory tests aimed at measuring driving impairment in that it requires sustained performance and attention over a relatively long period of time (1 hour) and is more realistic. Furthermore, a recent meta-analysis showed that laboratory tests poorly predict impairment on actual driving (Verster and Roth, 2012).

Aims

The primary objective of this study was to evaluate the effects of untreated AR on driving and cognition as well as the effects of two types of AR treatment & placebo in counteracting AR's effects on driving and cognition. The main hypothesis was that patients suffering from AR symptoms would show impaired driving performance. This detrimental effect would be (partially) counteracted by the use of AR drugs.

Methods

Nineteen Dutch speaking patients (nine female) completed the study. Main inclusion criteria were age between 22 and 45 years with a documented positive medical history of AR and documented AR treatment in the season preceding the study. Participants were required to be experienced drivers holding a license for at least two years and driving over 5000 km/year. Main exclusion criteria were the presence of any other form of (allergic) rhinitis, the presence or a history of psychiatric disorders or other contraindicated illness, e.g. asthma, diseases or trauma's of the central nervous system or impaired visual or auditory functions. Written informed consent was given before inclusion and patients were paid for their participation. The study was approved by the Medical Ethical Committee of Maastricht University and was conducted in accordance with the World Medical Associations Declaration of Helsinki [Seoul revision, 2008].

Study design

In this study AR patients were studied outside of the pollen season when natural exposure to allergens was minimal. This offered the experimenter control over AR symptoms experimentally by administering a nasal provocation test with pollen (or placebo). The study was organized following a double blind randomized 4-leg crossover repeated measures design. In each condition patients were challenged with either an allergen solution (sprayed in the nose) or placebo in combination with one of two medicinal allergy treatments or placebo. Table 1 summarizes the conditions and treatments. Drug treatment and nasal pollen provocation was administered in a double dummy fashion. On the four days prior to each testing day patients were treated once daily with a nose spray containing 27.5 microgram fluticasone furoate or placebo. On each testing day a final dose of the same spray was administered together with a single dose (capsule) containing either 10 mg cetirizine or placebo. Only either the capsule or the nasal spray could contain an active compound on a given test day. Both the active nasal spray and placebo were packed in blinded and identical containers as were capsules containing cetirizine or placebo.

Table 1. Conditions and treatments (administered in cross-over , randomized order)

Condition	Provocation type	Drug treatment type
PLAC	Placebo	Placebo
PROV	Grass / Tree pollen	Placebo
CETR	Grass / Tree pollen	Cetirizine
FLUT	Grass / Tree pollen	Fluticasone furoate

Driving test

The on the road driving test developed in our laboratory aims at overcoming common problems associated with driving simulators which seem a more safe and logical choice as an instrument to study driving. Contrary to almost all driving simulators this test is more sensitive, has been validated and does not provoke motion sickness, a side effect affecting almost half of the subjects tested in simulators (Classen et al 2011). The main outcome variable “weaving” as defined by the Standard Deviation of Lateral Position (SDLP) is a very reliable index (test-retest r=0.7-0.9) of individual driving performance and has proven to be sensitive to many sedating drugs. A clinically relevant increase in SDLP has been established in a series of studies investigating the effect of alcohol. The driving test consisted of two distinct parts. The first 45 minutes the participants’ task was just to drive the car under silent conditions. During the last 15 minutes a verbal Word Learning Test was administered through the speaker system of the car. The participant now also had to repeat and remember as many words presented to them during three successive presentations of a list of 15 words (1 per 2 seconds) forcing him/her to allocate attention to two tasks simultaneously.

Results

Driving Test

Figure 1 shows the results of the driving test. The left panel shows mean SDLP scores for the entire 60-minute test (overall SDLP) and the right panel shows the SDLP while patients were driving and simultaneously performing a memory task. The overall SDLP was different between conditions ($F_{(3,16)}$=7.44 ; p=0.002) and significantly higher for the untreated provocation condition compared to placebo : PROV > PLAC ($F_{(1,18)}$= 42.18; p<0.001). The SDLP during the memory test section showed a similar pattern although the SDLP was larger in all 4 conditions. Comparing over conditions showed them to be significantly different ($F_{(3,16)}$= 21.15 ; p< 0.001). Pair wise comparisons showed that both the untreated provocation condition as well as the condition with cetirizine treatment yielded a higher SDLP compared to placebo: PROV > PLAC $F_{(1,18)}$ =52.15; p< 0.001) and CETR > PLAC ($F_{(1,18)}$ = 4,61; p=0.046). The SDLP in the condition with fluticasone furoate treatment did not show a difference from placebo.

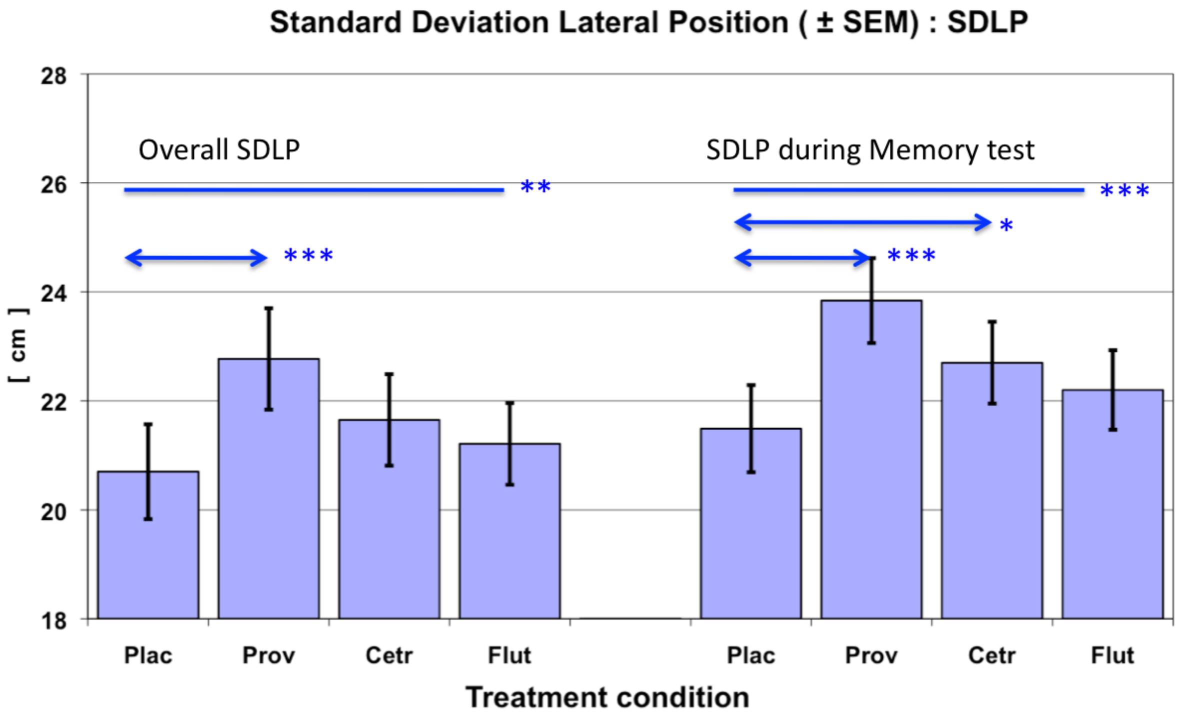

Figure 1. Mean (±SE) SDLP for all conditions of the driving test. Left panel shows SDLP for the entire test (60 minutes) and right panel shows SDLP during the memory test (last 15 minutes) Lines indicate overall significant difference between conditions, arrows indicate difference between two conditions (*= p<0.05; ** = p< 0.01; *** = p<0.001)

Discussion and conclusions

This study set out to study the effects of AR on the driving ability of patients. The method of nasal provocation to induce AR symptoms was reliable and caused different levels of AR symptoms in the experimental conditions. Without treatment AR symptoms were above clinically relevant levels for the duration of almost the entire test. Both systemic treatment with cetirizine as well as topical treatment with fluticasone furoate suppressed symptoms relative to the non-treated condition although not completely.
The impairing effects of AR per se on driving were large and significant. An increase in SDLP of 2.07 cm was seen in the untreated provocation condition which is comparable to the effect of driving with a BAC of 0.03 %[26]. Although this BAC level is under the legal limit in most countries it is nevertheless of some concern. In individual cases the effect could be larger which is particularly true if patients would also be taking a small dose of alcohol while symptomatic. The combined effects could then easily produce an SDLP increase of 2.5 cm, which is seen at the legal BAC limit of 0.05 % and putting the patient at risk. When an additional task is presented during the test the driving performance deteriorates further. While performing the memory test SDLP increases 2.35 cm relative to placebo in the untreated provocation condition. This (mean) effect is close to that of a BAC of 0.05 % and in individual cases it was higher.
We can conclude that patients suffering from untreated AR symptoms show impaired driving that, under conditions of extra cognitive load while driving, are almost comparable to the effects of a BAC of 0.05 percent. Furthermore, cognitive performance in this dual task

situation can be significantly impaired which may further interfere with other activities needed for safe travel. Treatment with either a systemic or topical treatment can partially correct this situation. Not treating AR symptoms will put patients at risk in situations where a maximal continuous attention and performance is required such as driving a car.

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Was this Preventable?

Gerald Waters. Research Director. Researching Impaired Driving in New Zealand.

Abstract

Context
In New Zealand in 2010 a family friend was killed by a drink driver. The driver had 17 previous convictions for drink driving. The driver had only been out of jail for 10 days before he killed our friend. He had been imprisoned for drink driving. I decided to investigate the historical and current state of drink driving in New Zealand and what measures were used, to good effect, to reduce the harm from drink driving overseas.

Objectives
I wanted to critique the current approach used to manage drink drive offenders in New Zealand and also to compile information on internationally recognised best practice initiatives used to reduce the harm from drink driving.

Key Outcomes
In New Zealand repeat offending accounted for around a third of the detections and harm caused by drink driving. Only 5% of detected drink drivers are assessed for alcohol problems. International research revealed that the use of alcohol ignition interlocks, rehabilitative efforts and Drug Courts reduced instances of drink driving and the harm caused by such behavior. I compiled this research into a series of papers and provided it to the ministries of Transport, Justice and Health; I also gave evidence to a Select Committee on proposed amendments to the New Zealand Land Transport Act 1998. The information I provided has helped facilitate the introduction to New Zealand of alcohol ignition interlocks, Drug Courts and more funding for internationally recognised best practice drink driver rehabilitation programmes.

Discussion and Conclusions
The compilation of peer reviewed evidence on the extent of the problems and possible solutions to drink driving in New Zealand helped inform decision makers on where their efforts were best focused. The research work continues in the form of a Charitable Trust 'Researching Impaired Driving in New Zealand'. The Trust will next focus on drug impaired driving and youth drink drivers.

Introduction

In March of 2010 a family friend was killed by a drink driver.

Newspaper reports[1] informed us that this was not the first time that the driver had been caught drink driving and that he had 17 previous convictions for drink driving. At Court during sentencing the judge informed the court that the driver had only been out of jail for 10 days before he killed our friend: he had been imprisoned for drink driving.

Whilst I understood that while there are cars and people are allowed to drink and drive there would inevitably be deaths but to have so many previous convictions and still come to this awful conclusion begged the question 'Was this preventable?"

[1] http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10661905 (Accessed April 15th 2013).

Repeat Drink Driving in New Zealand

I started researching repeat drink driving in New Zealand. A Google word search of 'repeat drink driving problems in New Zealand' led me to a meeting with Mr. Roger Brooking, Director of the 'Drink Driving Interventions Trust', Wellington[2]. Roger informed me of the low number of convicted drink drive offenders who are referred for alcohol assessment, around 5% (Brooking, 2010).

Information supplied to me by the Ministry of Transport (Ministry of Transport, 2010a) revealed that from 2005-2007 nearly a third (33%) of those drivers involved in alcohol related fatal crashes had a previous conviction for drink drive offending (see Table. 1).

Prior offending history period	*Number of prior drink-driving offences within prior history period*	*Proportion of drivers involved in alcohol-related fatal crashes between 2005-2007*
5 years	None One Two Three or more	77% 15% 5% 3%
10 years	None One Two Three or more	70% 17% 7% 6%
Lifetime	None One Two Three or more	67% 13% 7% 13%

Table 1: Proportion of drivers involved in alcohol-related fatal crashes from 2005-2007 by prior offending history

Every year there are approximately 30,000 convictions for drink driving offences and in 2010 it was reported that 23 percent of drink drivers were reoffenders (Ministry of Transport, 2010b).

From 2006-2010 there were 576 deaths in crashes where alcohol was a contributing factor. 364 of those deaths (63%) were in crashes caused by a high-risk driver who had either a blood alcohol level at least 50% over the adult legal limit or a prior alcohol offence (Ministry of Transport, 2012).

[2] The Drink Driving Interventions Trust was established in October 2010 to provide an interventions programme for repeat drink drivers on their third (or subsequent) conviction.

Research and Action

I found out that the New Zealand Government were amending the Land Transport Act and the drink driving laws through their Safer Journeys[3] initiative and I prepared a submission (Waters, 2010) for the Land Transport and Industrial relations Select Committee that included research on alcohol ignition interlocks, rehabilitation and other topics relevant to the proposed amendments. I also made an oral submission to the Select Committee. My evidence for this submission was gathered and reviewed from internationally recognised experts in the field of substance impaired driving and road safety and a list of these can be found in my submission (p.21).

In my submission I gave evidence of the effectiveness of alcohol ignition interlocks. My research supplied information showing that they are the best response to drink drivers. New Zealand started its first interlock program in 2012.

As well as my research into drink driving I had also started to write letters. They included asking the Minister of Transport "What are the benefits of allowing people to drink and drive?" and to the Minister of Justice "Whose job is it to investigate the circumstances that led to our friend's death?" After many requests regarding the latter, I soon realised that nobody would be investigating and decided to take on the role myself. I decided that the only way I was going to get all the information that I needed was to ask the driver that had killed our friend himself for it. I worked with the Department of Corrections and the prison services in drafting a letter asking for access to all the driver's previous offending history, all information relating to his encounters with the criminal justice system, all ACC[4] files and records and all data relating to rehabilitative efforts. The driver waived his privacy rights and I soon received boxes and folders full of files. The driver whilst having numerous convictions for drink driving also had nearly 100 other Alcohol and Other Drug (AOD) related convictions. I decided to research what worked in other countries for those whose repeat offending was AOD related. One of these initiatives was Drug Courts.

I started researching AOD offending in New Zealand and how Drug Courts work. I was helped in my understanding by a District Court Judge whose name I had seen in the press and was linked to stories on AOD related offending.[5] The judge told me that they too wanted Drug Courts for NZ. I was introduced to a United States Superior Court Judge and expert in the field of Drug Courts, Judge Peggy Hora. Judge Hora provided me with research and data on Drug Courts. I then started researching AOD related offending and repeat offending in New Zealand.

I again met and worked with Roger Brooking who provided me with essential material on the state of AOD repeat offending and the criminal justice system in New Zealand. I returned to my global research and worked with experts who showed me that in other countries the use of therapeutic jurisprudence or TJ, which addresses the underlying causes of offending, had been proven to have a more positive impact on reducing reoffending.

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[3] Safer Journeys is the New Zealand government's strategy to guide improvements in road safety over the period 2010 to 2020.

[4] The Accident Compensation Corporation (ACC) is a New Zealand Crown entity responsible for administering the Accident Compensation Act 2001. The Act provides financial compensation and support to citizens, residents, and temporary visitors who have suffered personal injuries.

[5] http://tvnz.co.nz/national-news/govt-s-head-in-sand-over-drug-courts-3948847 (Accessed April 15th 2013).

I decided to make my findings available to the public and constructed a paper called 'The Case for Alcohol and Other Drug Treatment Courts in New Zealand' (Waters, 2011). I sent a copy of my paper to the Minister of Justice, at the time, the Right Hon Simon Power. I had already had some considerable correspondence with the Minister and his senior advisor. The Minister read the paper and then came to my house in June 2011 to meet and discuss this research and other related matters. We talked about the value of Drug Courts and their ability to reduce reoffending. He told me that the Law Commission had also suggested their use in a recent paper on the control and use of drugs (Law Commision, 2010). Before he left that day the Minister told me that he would be looking into the matter personally.

New Zealand started its first pilot Drug Courts in 2012 as part of the Drivers of Crime package (Ministry of Justice, 2011). The Government proposed to invest up to $2 million a year for five years for the AOD treatment services associated with the pilot Drug Court for adults in greater Auckland. The recommended target group is offenders with AOD dependence who are facing up to 3 years in prison for offences where AOD has been a contributing factor (including repeat drink driving). My paper was also cited and used in lectures given by Judge Peggy Hora in Auckland and Wellington.

In 2011, I received an invitation to give a presentation on 'Drink Driving in New Zealand' at an alcohol ignition interlock symposium, held by the Traffic Injury Research Foundation in Palm Springs, California. At the symposium I found out that I had been nominated for and became the first recipient of the inaugural 'Barry Sweedler' Award.

At the symposium I met with experts in many fields of drink driving and road safety and the conversations I had convinced me that I should be more organised in my approach. I had been referred to as many things by the media since I started my research: an advocate, a lobbyist. On reflection all I had ever done was provide research and disseminated this information to encourage collaboration amongst those who may find this information of use as well as to educate and inform the wider public on the issues involved in the research. This method of working is consistent with those described for a Charitable Trust and a trust was formed in 2012. The Formation of the Charitable Trust 'Researching Impaired Driving in New Zealand' holds me to this impartial, evidence based framework and provides a formal support structure around the work that I did previously as an individual. The formation of the Trust also provides stability, depth and continuity for the research work.

While taking part in a Drug Court convention in Auckland in March 2012, I met with a representative of the Ministry of Health who informed me of $1 million of funding for the rehabilitation of repeat impaired drivers that had been allocated yearly as part of the aforementioned Drivers of Crime package. I had been researching the rehabilitation of repeat offenders and made this research available to the Ministry of Health (Waters 2012b). In December of 2012 I was invited by the Ministry of Health to help, in my capacity as advisor, in the allocation of this funding to those organisations that had tendered for such services.

In June 2012 I met with the then Associate Minister of Transport, The Hon Simon Bridges (whose portfolio covered road safety) and discussed my work and matters relating to substance impaired driving in New Zealand. At this meeting the Minister expressed his interest to host the official launch of our Charitable Trust at Parliament. This launch took place in December 2012. Also in 2012, I was also asked by the Ministry of Justice to provide information on the effectiveness of alcohol ignition interlocks (Waters, 2012a).

In 2011, I met with Superintendent John Kelly, who was then a Strategic Road Policing Manager. He invited me to come out on Compulsory Breath Testing operations with a Traffic Alcohol Group and their ‘booze buses’[6] in the Auckland area. I spent 10 months out on operations. I observed the Police at work and I interviewed those suspected of drink driving. I made public a report on these observations (Waters, 2012c) .This research was supplied to the Office of the Auditor General, who were soon to conduct a performance audit of the New Zealand Police’s efforts to enforce drink driving laws (Office of the Auditor General, 2013) and also provided this report to the Minister of Police, who had voiced her concerns of drink driving enforcement.[7] John Kelly has now retired from the Police force and is currently the Chairman of ‘Researching Impaired Driving in New Zealand’.

All the compiled research papers were sent to relevant organisations and recognised experts in the fields of substance impaired driving and road safety for review before their dissemination.

Discussion

The compilation of peer reviewed evidence on the extent of the problems and possible solutions to drink driving in New Zealand has helped inform decision makers on where their efforts were best focused. In the three years since the research commenced New Zealand has introduced:

- Pilot Alcohol and Other Drug Courts
- Alcohol Ignition Interlock Programme
- Funding for internationally recognised best practice drink driver rehabilitation programmes

Researching Impaired Driving in New Zealand (RIDNZ) has now been contracted by the Ministry of Health to develop the framework for the evaluation of the Repeat Impaired Driver programmes that have been funded by the Ministry of Health.

The Trust is researching and compiling data regarding the construction of effective and economically viable substance impaired driving initiatives for New Zealand to help in the reduction of harm from such behavior. The Trust supplies information to government and non-government organisations as well as the general public. The Trust is currently researching drug impaired driving and youth substance impaired driving both in New Zealand and worldwide. All of the research work that I have done as an individual and as Director of the Trust has been self funded. I have given numerous media interviews with the intention of keeping the issues surrounding substance impaired driving in New Zealand at the forefront of public opinion.

Since the research work has started there has been a noticeable decrease in the number of road deaths and alcohol related road deaths as reported by the Office of the Auditor General (2013. p.7):

[6] These vehicles are used for administering blood-alcohol tests (to suspected drink drivers); generally a mid-size bus converted or fitted out for this purpose.

[7] The Minister of Police, the Hon Anne Tolley, expressed her concerns in a media release available at: http://www.newstalkzb.co.nz/auckland/news/nbpol/1380806883-police-asked-to-review-drink-driving-test-efficiency (Accessed April 15th 2013).

> 'After we began our audit, the 2011 road toll was released. It showed a significant decrease in the number of road deaths, from 375 in 2010 to 284 in 2011. The number of alcohol-related road deaths fell significantly, from 142 in 2010 to 85 in 2011. The 2012 road toll was 308, which is the second-lowest annual road toll since 1952.'

While the question: was the death of our friend preventable? still remains unanswered, it is hoped that the research work, and publicity that has ensued from this question, may help prevent further deaths, injuries and crashes from substance impaired driving in New Zealand.

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Exploring the influences of country-level factors on mid-age women's drink driving attitudes

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Abstract

Background
Drink driving remains a major cause of serious and fatal car crashes in Australia and internationally. While this problem is more prevalent among male drivers, the rates of female intoxicated drivers have increased steadily over the past decades in many motorised countries. A combination of police enforcement, media awareness campaigns, and community initiatives has played a key role in reducing incidents of illegal drink driving by targeting public drink driving attitudes. However, important cultural differences in regards to the tolerance towards drink driving have been noted. While many countries, including Australia, have a legal Blood Alcohol Concentration (BAC) limit of .05 or higher, some countries have moved towards a zero –or low tolerance approach to drink driving; several European countries, including Sweden, Hungary, Slovakia, and Estonia currently enforce .00 or .02 BAC limits.

Aim
The current study aimed to increase the understanding of women's attitudes towards drinking before driving by exploring the impact of country-level differences in BAC-levels and tolerance towards drink driving.

Methods
Semi-structured interviews were conducted with a convenience sample of Australian (*n* = 15) and Swedish (*n* = 15) mid-aged women, a group that has received little prior research attention. Thematic analysis explored participant's knowledge and attitudes towards drink driving.

Results
Several key themes were developed from the data including women's understanding of the relationship between alcohol consumption and BAC levels, the effect of alcohol on driving ability, views of the legal BAC limit in each country, cognitive disassociation between alcohol and driving, and the morality and ethical implications of drink driving.

Discussion and conclusions
Findings illustrate that women's attitudes towards driving while intoxicated are influenced by country-level BAC and tolerance towards drink driving. Implications for road safety are discussed. Future research may expand on the knowledge of women's drink driving attitudes by conducting cross-cultural studies with broader samples of women.

Introduction

Drink driving is a serious road safety problem in many parts of the world, with around 20% of fatal crashes in high income countries involving a driver under the influence of alcohol (Global Road Safety Partnership, 2007). Alcohol consumption impairs a range of cognitive, motor, and behavioural functions that are essential to driving (Ogden & Moskowitz, 2004) and is linked to both crash risk and injury severity. The relationship between BAC level and the probability of being involved in a crash was first quantified in the 1964 Grand Rapids Study. Findings from this study and others like it showed that a significant increase in crash risk occurs at a BAC of around 0.04 and continues to rise exponentially as consumption increases (Blomberg, Peck, Moskowitz, Burns, & Fiorentino, 2009). Significant impairment at BAC levels less than 0.04 has, however, been noted in other research (e.g., Ogden & Moskowitz, 2004).

Most alcohol-impaired drivers are male, a patterns which holds true in many, if not all, parts of the motorised world. However, the past decades have seen an increase in female drink driving rates (e.g., Robertson, Liew, & Gardner, 2011; Wylie, 1995), often paralleled by a stabilisation or decrease in male drink driving rates (Tsai, Anderson, & Vaca, 2010). Several reasons for women's increased involvement in drink driving have been suggested, including increases in driving exposure, alcohol consumption, and risk taking behaviour (Robertson et al., 2011; Roche & Deehan, 2002). Regardless of the cause of women's alcohol-impaired driving, these changes necessitate a move away from the view that drink driving is predominantly a male problem.

In the current study, drink driving behaviours and attitudes will be examined among mid-aged women in Australia and Sweden. This group has previously received little attention from researchers, although they comprise a substantial proportion of female drink driving offenders. In Sweden, Jones and Holmgren (2009), found that the average age of female drink drivers who provided venous blood sample between 2000 and 2007 was 41.8 years (*SD* = 13.6). In Queensland, Australia, analysis of drink driving detections from 2000 to 2011 show that women aged 40-49 years make up 18.4% of all female cases, only rivalled by women aged 30-39 (24.7%) (Armstrong, 2013).

In addition to increasing the knowledge of mid-aged women's approach to drink driving, the current study sought to discern cultural differences in drink driving attitudes and behaviours among the participants. In particular, the impact of different BAC levels for legally permissible driving was examined. While the general trend over the past decades have been towards a lowering of the BAC, differences still exist. A range of countries and jurisdictions have adopted limits of 0.05 to 0.08, while others have taken a zero or near zero-tolerance approach to drink driving with BAC limits of either 0.00 or 0.02. Research indicates that lowering BAC levels decreases crash rates (Hingson, Heeren, & Winter, 2000), however, it is likely that part of this reduction can be attributed to increases in enforcement and public awareness of drink driving that often accompany changes to BAC levels (e.g., Mann et al., 2001; Nakahara & Ichikawa, 2011).

Australia and Sweden

The BAC limit in Sweden has been set at < 0.02 since 1990 and at < 0.05 in the Australian states since the 1980s and 1990s. Based on cases with known BAC in 2008, around 29% of fatally injured Australian drivers had a BAC equal to or above 0.05. In 2012, almost 18% of all killed drivers with known BAC in Sweden were recorded with a BAC above the legal cut-off (Trafikanalys, 2013).

Methods

The findings presented here emerged from the qualitative component of a larger study investigating drinking culture among Australian and Swedish women. The qualitative component was guided by an ethnographic methodology and data collection was conducted through a series of telephone and face-to-face interviews.

Participants
A convenience sample of 15 mid-aged women (range 45-58 years) was interviewed in each country. All participants completed the Alcohol Use Disorders Identification Test (AUDIT), a 10-item survey designed to assess levels of harmful or hazardous drinking. The average age of the Swedish women was 52.5 years (SD = 4.8) and the majority were married or in a relationship (n = 10). The average age of the Australian women was 52.2 years (SD = 3.4), with 10 women being married or living in de-facto relationships. Three Swedish women and five Australian women scored above the cut-off for risky drinking on the AUDIT[1].

Materials
All interviews were guided by a semi-structured protocol containing questions such as *"What are your thoughts on the current legal limit for drink driving in Australia/Sweden (should it be lower or higher)?"* and *"Do you believe that driving experience can mitigate the effects of alcohol on driving ability?"* The AUDIT was used as it has demonstrated high cultural applicability (Saunders, Aasland, Babor, Fuente, & Grant, 1993) as well as strong psychometric properties (Reinert & Allen, 2007). A total score of ≥ 6 was used to classify risky drinkers as this cut-off has been found to yield optimal levels of sensitivity and specificity among mid-aged women (Aalto, Tuunanen, Sillanaukee, & Seppä, 2006).

Procedure
Interviews in Sweden were conducted either face-to-face or by telephone, however, all interviews in Australia were conducted by telephone. Prior to the interviews, participants in both countries were greeted and given an overview of their participation. The researcher stressed that the interviews were confidential and that honest responses were valued. The AUDIT was administered to participants after the completion of the interviews. All interviews were recorded and transcribed verbatim.

Data analysis
Interview transcripts were thematically analysed. Meaning units were identified, coded, and categorised. As the analysis progressed, categories were continuously renamed and modified to ensure they reflected the increasing number of codes. Finally, categories were organised into broader themes allowing general patterns in the data to emerge.

Results

Several similarities were uncovered between the two groups. Reflecting broader public sentiments, women in both samples viewed drink driving as morally wrong and inexcusable, often citing the risk alcohol-impaired drivers posed to other 'innocent' road users. While about half of the sample in each country believed that driving experience could mitigate some of the impact of alcohol on driving ability, this was not seen as an excuse to drive with BAC levels above the legal cut-off. Among Australian women in particular, the negative attitudes toward drink driving was couched within a broader culture of responsibility and caution that reflected their age as well as their roles as women and mothers. Two examples; *"I think you become a bit more of a citizen, you know, you get a bit older and it's not all about you, it's also about living in a society that has some sort of standards"* (Participant A, risky drinker) and *"I think us women who are mothers become very cautious"* (Participant O, risky drinker). Several women in both countries described how, at their age and among their

[1] Swedish version of the AUDIT defines standard drinks as 12g of pure alcohol while the Australian version uses a 10g definition. This might bias results towards fewer identified risky drinkers in the Swedish sample.

friends, they were expected *". . . to do the right thing"* (Participant H, risky drinker) in terms of drink driving and that they themselves would be willing to intervene to stop a friend from driving if they thought she was over the legal BAC. Among the Swedish women, removing the drivers' keys or calling the police were mentioned as potential strategies; *"If I knew that anyone, for instance, was, was under the influence of alcohol and got in the car I would call the police straight away"* (Participant 1, low-risk drinker).

While several behavioural and attitudinal similarities were found between the two groups, further analysis revealed that many of these similarities were superficial. Most significantly, the majority of the Swedish women appeared to view drinking and driving as two separate activities; *"Either you drive or you drink"* (Participant 8, low-risk drinker). While the lower BAC placed limits alcohol consumption in driving situations, this was not the only reason behind these attitudes. Many women expressed a strong cognitive disassociation between drinking and driving, two examples; *". . . if you are going to drive you should absolutely not drink. Not even half a glass"* (Participant 3, low-risk drinker) and; *"I think it is natural not to drive a car in those situations"* (Participant 4, low risk drinker).

The majority of Swedish women displayed poor knowledge regarding the level of alcohol that can be legally consumed before driving. When asked to discuss their opinions of the current BAC limit many of the women sought information from the interviewing researcher in order to construct their argument. For instance; *"Don't know, zero point two* [sic] *how much would you be able to drink then? I don't know where it, what the limit is, is it one beer or..?"* (Participant 5, risky drinker). A further few women appeared to significantly over-estimate the impact of alcohol consumption on BAC levels. For instance, one woman described how spotting a police van while driving had made her concerned about a mid-strength beer she had consumed the previous night. Thus, the restrictions placed on driving after drinking by the Swedish BAC limits, the relatively low levels of knowledge regarding the impact of alcohol consumption on BAC levels and, importantly, the cognitive disassociation between drinking and driving prompted the majority of the Swedish women to take an either or approach to drinking and driving.

Among the Australian women, safe and morally defensible driving was more closely linked to the BAC limit enforced in Australia. Rather than abstaining the majority of women chose to place limits on their alcohol consumption, often applying different variations of the 'one glass rule' to ensure a legal BAC level when driving. However, several of the Australian women spoke of a 'Grey Zone' that denoted instances when they, or their friends, had driven while potentially over the BAC limit. Speaking of her female friends, one participant related that; *"Um, they won't be much over but, you know, they won't be much over but, in my mind, they will be over, yeah"* (Participant F, low-risk drinker). Another woman described a similar situation; *"And then there's sort of decision and you know, I know I do occasionally, I'm only allowed to have two, but I have had three but I will drive, yeah"* (Participant H, low-risk drinker). This reveals an interesting paradox as, for some women, 'Grey Zone offending' did not appear to challenge their self-image as responsible drivers. One example:

> ". . . and I still think that we take risks from time to time and get in a car, yeah. But generally, generally I think I feel myself and most of my friends are very, very wary about getting in a car after they've been drinking." (Participant C, risky drinker)

While not seen as ideal, it is possible that instances of 'Grey Zone' drink driving was viewed differently from 'actual' drink driving, an act that was morally indefensible. Driving while 'just over the limit' might not have been conceived as reckless enough to contradict the broader culture of responsibility and caution many of the Australian women ascribed to. For instance, one woman spoke of how in instances of Grey Zone drink driving, the prospect of being apprehended was a stronger deterrent than the risk of injuring other road users:

> "I'm really terrible, obviously I would hate to hurt somebody doing it, ah, but I'm really scared about going to the watch house *laughs* . . . I suppose I think it's like if I did drink I would be, you know, just barely over the, barely over and I feel, I suppose I feel safe then" (Participant F, low-risk drinker)

Thus, the demarcation between alcohol consumption and driving was found to be less clear among Australian than Swedish women. This difference was further evident in the views held by the two samples in relation to current BAC limits. When discussing the current BAC in Sweden, all but one woman expressed opinions in favour of a zero-tolerance (i.e., BAC of 0.00) approach to drink driving. A few women believed that zero-tolerance would preclude drivers from taking a chance or that the approach was necessary as the impact of BAC levels on driving ability is contingent on variable factors such as a person's tolerance to alcohol. However, while supporting a zero-tolerance approach, many of the interviewed women spontaneously stated that the current Swedish legal BAC was 'very low' and that a BAC around 0.02 might not critically impair ones driving ability. This was an interesting finding as it indicated that the Swedish sample were willing to forgo alcohol in the context of driving even at levels perceived to be relatively safe.

In contrast, the majority of Australian women thought the current Australian legal BAC to be 'reasonable'. While believing that the limit should be kept at 0.05, a few women did, however, note that it was somewhat arbitrary, again referring to individual differences in the relationship between BAC and driving impairment. In addition, a few of the women spoke of the potential advantages of a zero-tolerance approach in terms of removing the 'guesswork' from driving after drinking. Nonetheless, the current BAC limit was generally seen as safe and appropriate. Lowering the limit or adopting a zero-tolerance approach was, by the majority of women, seen as impractical, impossible or even as a *"prohibition type of situation which is anti-social"* (Participant D, low-risk drinker).

Discussion

Women in both the Swedish and Australian samples held strong negative views of drink driving and experienced social pressure to abide by the legal BAC limit in their respective countries. However, the Swedish sample expressed a strong cognitive disassociation between drinking and driving and shared the opinion that the BAC limit could be lowered to 0.00. In contrast, driving after drinking (relatively) small amounts of alcohol was a regular part of social situations for the Australian women. Lowering the BAC limit was seen as impractical, impossible, or anti-social. While still regarding driving at illegal BAC levels as morally wrong, some women in the Australian sample occasionally drove although they might be close to, or potentially over, the legal BAC. This finding illustrates the different approach to drinking and driving in the two countries. Due to the mental separation between driving and drinking among the Swedish women, any alcohol consumption before driving was seen as ill-advised. Among Australian women, safe and morally defensible driving was often equated to a BAC level around the legal cut-off. Thus, beyond its practical implications for driving, lower BAC limits might also help foster a broader social environment where alcohol consumption and driving are thought of as separate activities. Future research is needed to substantiate these findings in broader samples of both men and women.

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Putative Mechanisms Underlying Risky Decision-Making in High Risk Drivers

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Abstract

Introduction
The Iowa Gambling Task (IGT) is a neuropsychological task that measures two types of decision-making: i) under risk, and ii) under ambiguity. Investigations using the IGT in groups of high risk drivers (HRDs) consisting of driving while impaired (DWI) offenders suggest that a deficit in decision-making under risk is present in HRDs. However, the IGT may be measuring broader cognitive dimensions other than decision-making. Validation of these findings is needed with more direct measurement of decision-making under risk in a more representative sample of HRDs. It is hypothesized that: 1. HRDs will perform worse than Controls (CTLs) on a task that measures decision-making under risk alone, the Game of Dice Task (GDT); and 2. Decision-making under risk via the IGT will be significantly associated to the GDT.

Methods
Male HRDs are included if they are between 19-40 years old, possess at least three moving violations (i.e., speeding) in the previous two years or ≥ 2 DWI convictions. CTLs have none of the above. Participants ($n = 43$ recruited of $n = 45$ targeted) complete the IGT, the GDT and questionnaires.

Results
In preliminary analyses, HRDs (n= 27; *mean age* = 29) did not differ from CTLs (n= 15; *mean age* = 25.0) in their scores for decision-making under risk on the IGT or the GDT. Additionally, scores on the IGT were not significantly correlated to scores on GDT. Exploratory analyses after dividing HRDs according to DWI involvement (i.e., Y/N) were done. Results suggest that HRDs who have not been convicted of DWI perform better on the IGT and GDT compared to CTLs and HRDs who have been convicted of DWI, who are comparable.

Conclusion
Preliminary findings do not support hypotheses. Given the heterogeneity of HRDs in this study, investigation of HRDs based on DWI involvement may better elucidate the role, if any, that decision-making plays in HRD.

Background

Road traffic safety is major global health concern. In 2004, road traffic crashes (RTC) accounted for 1.3 million deaths and were ranked as the 9th most important burden on global health ("Global Burden of Disease 2004 Update," 2008). Numerous human factors contribute to the large number of road traffic fatalities, including lack of seatbelt use, excess speed, and drunk driving, also known as Driving While Impaired (DWI) by alcohol. Based on findings from epidemiological data, researchers and licensing program administrators are increasingly focused on a relatively small but particularly dangerous subgroup of the driver population, known as high risk drivers (HRD). One operationalization of HRD signals drivers who have either: 1) three or more distinct driving events (i.e., Criminal Code offence, collision or road traffic violation such as speeding, driving without a seat-belt, running a red light or stop sign and driving with a suspended licence) over the course of a two year period; or 2) been convicted for a first impaired driving offence (DWI) at BAC >0.16, refused to provide a breath sample, or have committed repeated DWI offences (Vezina, 2001). HRDs, compared to normal drivers, are over four times more likely to be implicated in deadly RTCs. A greater understanding of what leads some individuals to repeatedly engage in high risk driving behaviour is clearly needed.

Deficits in decision-making appear to underlie risky driving behavior (Lev, Hershkovitz, & Yechiam, 2008). The Iowa Gambling Task (IGT) is a widely used neuropsychological task measuring decision-making. The IGT is a complex task that measures decision-making under ambiguity (outcome probabilities unknown) in the first part of the task and decision-making under risk (outcome probabilities known) in the later part of the task. In previous studies in our laboratory as well as others, groups of HRDs consisting for the most part of DWI recidivists, show marked impairment in the last blocks of the task, suggesting a deficit in decision-making under risk (Kasar, Gleichgerrcht, Keskinkilic, Tabo, & Manes, 2010; Maldonado-Bouchard, Brown, & Nadeau, 2012; Yechiam, 2008). One important facet about the IGT is that it relies on the integrity of diverse cognitive processes, such as reversal learning and working memory (Busemeyer & Stout, 2002; Fellows & Farah, 2005). In order to accurately investigate impaired decision-making as a cognitive pathway to HRD, it is important to determine whether impaired performance on the IGT is due to a deficit in decision-making under risk or to some other impairment. To do this, use of a well-validated task that measures decision-making under risk alone is needed. The Game of Dice Task (GDT), which has successfully identified impaired decision-making under risk in a variety of clinical populations (Brand, Labudda, & Markowitsch, 2006; Brand, Recknor, Grabenhorst, & Bechara, 2007; Labudda et al., 2008), seems well suited for this purpose.

In sum, preliminary evidence suggests that HRDs have a marked impairment in decision-making under risk, which may represent a neurocognitive pathway leading to HRD behaviors. Given the complexity and lack of ecological validity inherent in the tasks used to date, validation of these findings using more appropriate measures of decision-making under risk is needed.

Aims

The purpose of this study is to use two neuropsychological tasks to elucidate deficits in decision-making under risk as a putative mechanism underlying risky decision-making in HRDs. The main objectives of the current study are to (1) investigate decision-making under risk in a broader sample of HRDs and (2) validate the use of the IGT for this purpose using a more pure measure of decision-making under risk, the GDT.

Two hypotheses are tested: Hypothesis 1- HRDs will exhibit a deficit in decision-making under risk as measured by both the IGT and the GDT; Hypothesis 2 - decision-making under risk as measured by the IGT (Blocks 3-5) will be significantly associated to the GDT.

Methods

Recruitment

A total of 45 male participants aged 19-40 are targeted for recruitment in the current study (30 HRDs and 15 controls) through advertisements in local newspapers as well as databases and other research studies in the Addictions Research Program at the Douglas Mental Health University Institute in Montreal, Quebec, Canada. Individuals who are interested in participating in the study complete a preliminary telephone screening and if eligible, are assigned an appointment at their convenience. Upon arrival at the laboratory, participants are asked to provide proof of their identity and driving record, undergo a Breathalyzer© test to determine study eligibility (BAC 0.00 mg/dl) as well as read and sign the informed consent form. They then proceed to the study session, which consists of two counterbalanced neuropsychological tasks (IGT and GDT) and several questionnaires that assess alcohol and drug intake, driving behaviors and attitudes as well as sociodemographic information. After their participation, participants are debriefed about the study and are given $50 compensation for their time and effort.

Measures

The Iowa Gambling Task (IGT) and the Game of Dice Task (GDT) will be used to measure decision-making. In the IGT, the participant must choose between four decks of cards, two of which lead to higher immediate wins but long term losses (disadvantageous) and two of which lead to lower immediate wins but long term gains (advantageous). Adaptive performance on the IGT requires participants to pick from advantageous decks more than disadvantageous decks. The first two blocks of the IGT measure decision-making under ambiguity and the last three blocks of the IGT measure decision-making under risk. IGT scores are calculated based on five blocks of 20 trials each (100 trials total). For each block, the total number of selections from disadvantageous decks is subtracted from the total number of selections from advantageous decks. The IGT Total Score is the sum from all the decks, IGT under ambiguity is the mean score from blocks 1 and 2 and IGT under risk is the mean score from blocks 3-5.

In the GDT, participants bet on the outcome of several thrown dice. Advantageous betting decisions involve three or four number combinations (i.e. betting $100 that a 1, 2 or 3 will be thrown) as they are the most likely to occur and involve low gains/losses whereas disadvantageous betting decisions involve one or two number combinations (e.g. betting $1000 that a 1 will be thrown) as they are the least likely to occur but involve high gains/losses. Because the outcome probabilities of rolling a dice are known (the chances of rolling a 6 for example, is always 1/6 while the chances of rolling a 3,4,5 or 6 is always 4/6), the GDT measures decision-making under risk. The GDT Total Score is derived from subtracting the total number of disadvantageous betting decisions from the total number of advantageous betting decisions. A series of questionnaires are also administered to collect sociodemographic data, data regarding the participant's alcohol and drug consumption as well as driving attitudes and behaviours.

Results

Progress

To date, 43 of the 45 study participants have been recruited and tested. Data from 42 of the tested participants have been processed and are used for the analyses here.

Testing of Primary Hypotheses (see Table 1 below)

Hypothesis 1: Mann-Whitney U independent samples tests was performed using the aggregate scores from blocks 3-5 of the IGT as well as the aggregate scores of the GDT to compare HRDs and CTLs. Hypothesis 1 was not supported. CTLs were not found to have significantly lower scores for decision-making under risk as measured by the IGT or the GDT.

Hypothesis 2: A bivariate correlation was performed for Hypothesis 2 using the aggregate scores from blocks 3-5 of the IGT as well as the aggregate scores of the GDT. Hypothesis 2 was not supported. Aggregate scores for decision-making under risk as measured by the IGT (blocks 3-5) were not found to be significantly correlated to the GDT.

Exploratory Results (see Table 2 below)

Given that the majority of the preliminary data regarding decision-making deficits in HRDs were conducted with samples of DWI offenders, the HRD group was divided according to whether or not they had ever been convicted of a DWI offence. Though not reaching significance (possibly due to the small sample size), a consistent pattern based on the IGT and GDT scores emerged. For decision-making under risk (measured by blocks 3-5 of the IGT as well as the GDT), alcohol-related HRDs performed similarly to controls while both groups were outperformed by the alcohol-unrelated HRDs.

Discussion and conclusions

Preliminary data analysis does not support the hypothesis that decision-making under risk underlies the risky behaviour of HRDs as a whole. Furthermore, concurrent validation of the IGT data (specifically blocks 3-5) using the GDT was not supported. The majority of research into decision-making in high risk drivers, however, has been conducted using samples of DWI offenders. Exploratory analysis in this study suggests that looking at subgroups within the broader HRD sample may provide a more thorough understanding of the role that decision-making plays in high risk driving. Supplementary data analysis using the full range of variables available in the dataset as well as a more varied statistical repertoire will better elucidate decision-making in high risk drivers.

Table 1
Sociodemographic characteristics, substance use, Iowa Gambling Task (IGT) scores and Game of Dice (GDT) scores for High Risk Drivers (*n*=27) and Controls (*n*=15)

	High Risk Drivers		Controls	
	Mean	*SD*	*Mean*	*SD*
Age	29.04	5.02	24.80	4.71
Education	13.96	2.59	13.60	2.30
AUDIT	7.91	5.46	8.00	2.74
MAST*	11.61	11.07	3.00	1.23
DAST	1.70	1.26	2.00	2.55
Self-report DWI current	1.87	0.82	1.60	0.89
Self-report DWI lifetime	2.96	1.22	2.20	0.84
Age at first drink	13.61	2.84	14.60	1.14
Age at first intoxication	14.87	3.29	15.60	0.89
IGT Total Score	149.04	14.97	152.40	12.76
IGT Ambiguity Score	29.83	3.27	29.00	4.30
IGT Risk Score	31.09	4.99	29.87	3.51
GDT Total Score	39.30	8.67	37.20	9.65

AUDIT: Alcohol Use Diagnostic Identification; DAST: Drug Abuse Screening Test; MAST: Michigan Alcohol Screening Test; IGT: Iowa Gambling Task; GDT: Game of Dice Task
*significant at $p < .05$

Table 2
Iowa Gambling Task (IGT) scores and Game of Dice (GDT) scores for Alcohol-Unrelated HRDs (*n*=10), Alcohol-Related HRDs (*n*=17) and Controls (*n*=15)

	Alcohol-Related HRDs		Alcohol-Unrelated HRDs		Controls	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
IGT Total Score	149.13	15.56	149.20	14.52	145.78	12.63
IGT Ambiguity Score	28.35	3.54	26.60	3.72	28.29	4.83
IGT Risk Score	30.35	3.95	32.63	6.22	29.50	2.65
GDT Total Score	37.41	10.19	43.00	4.35	37.33	11.25

IGT: Iowa Gambling Task; GDT: Game of Dice Task

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Experiences with the application of the hair analysis on ethyl glucuronide in the traffic medicine in Switzerland

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Background:
The Institute of Legal Medicine in Zurich is one of the institutes in Switzerland, which investigates the fitness to drive in order of the Road Traffic Licensing Department. Since 2008 the medical examination of motorists with alcohol problems includes a hair testing for the substance of ethyl glucuronide.

Aim:
The aim of this study is to work out the position of the hair analysis in Switzerland in the context of traffic medicine.

Methods:
About 454 cases from the year 2011 are evaluated. The past medical history and the traffic history are compared with the results of the traffic medicine examination including the hair analyses. Furthermore the traffic medicine diagnosis and the licensing requirements are listed and evaluated statistically.

Results:
266 (59%) from the 454 cases received a positive assessment and 188 (41%) a negative one. From all the positive assessments about 216 (81%) people could show with the hair analyses that they haven't consumed alcohol at all in advance to the examination. Otherwise 38 people (20%) of all the 188 negative assessments had no alcohol consume in the months before the examination, but they received a negative report because of other reasons.

Discussion and conclusion:
We can show that the hair analysis for ethyl glucuronide is a very important instrument in the traffic medicine examination but not the only one. The case history, the classic examination and reports from other doctors still are irreplaceable.

In our speech we will present the Swiss system of traffic medicine in motorists with alcohol problems and our experience with the hair testing for ethyl glucuronide in the traffic medicine assessment.

Background

In Switzerland, expert medical reviews of fitness to drive are carried out primarily in six departments of traffic safety at the institutes of legal and forensic medicine. The Department of Traffic Safety at the Institute of Legal and Forensic Medicine at the University of Zurich (IRM UZH) is the lead department. The Department has been in existence for more than 30 years and was the first department of traffic medicine in the country. Each year, a team of 20 doctors examines about 10,000 people regarding their fitness to drive.

Even though the number of fatalities and those seriously injured in road traffic accidents has fallen in recent years, politicians demanded further measures to improve traffic safety, and the package of the *Via sicura* [traffic safety] programme was approved by parliament in June 2012 (Bundesamt für Strassen (ASTRA), 2013). Some of the associated legislative changes are related to alcohol. From January 1st, 2014, any person caught driving with a blood alcohol concentration (BAC) of 1.60 g/kg or more will have to undergo expert medical review of his or her fitness to drive (Bundesamt für Strassen (ASTRA), 2012). Until that date, the BAC cut-off for an obligatory expert medical review following a first drink-driving offence remains 2.5 g/kg (Bundesamt für Strassen (ASTRA), 2000).

As a rule, expert medical review of fitness to drive includes inspection of the Cantonal Driver and Vehicle Licensing Agency files, a past medical history, physical examination, requests for medical reports from other doctors, blood tests for the traditional alcohol biomarkers – carbohydrate deficient transferrin (CTD), gamma-glutamyl transferase (GGT), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and mean corpuscular volume (MCV) – and analysis of hair for the alcohol metabolite, ethyl glucuronide (EtG). The findings are integrated into the expert report and a diagnosis made with respect to traffic safety. The diagnosis is based on the information supplied in the manual for expert medical review in traffic medicine, issued by the Swiss Society of Legal and Forensic Medicine (Seeger, 2005, pp. 25/26). The following alcohol-related diagnoses are used in the relevant cases: alcohol dependence (according to the International Classification of Diseases, ICD-10) and alcohol misuse relevant to traffic safety. Once the diagnosis has been made, fitness to drive is assessed and further procedures established. Following our internal guidelines, in the event of an alcohol-related diagnosis relevant to traffic safety, the driving licence will be returned only subject to the restriction of total alcohol abstinence imposed for 2-3 years.

Hair analysis for ethyl glucuronide has been used routinely at the IRM UZH since 2008, and has led to various changes in the expert medical review. In order to define these changes and substantiate them scientifically, as well as to make any necessary adjustments to the procedures, we initiated a research package of different projects. For example, we analysed the changes in monitoring drivers under restrictions, showing that our current investigation procedure (brief examination and hair analysis) is not only better in determining alcohol recidivism but also that such recidivism occurs less frequently (Eschenbacher, 2012, p.55/56). The use of hair analysis has also allowed us to introduce the restriction of zero tolerance when driving for certain drink driving offenders. This restriction is recommended for drivers who consume only moderate quantities of alcohol or those who have had problems previously but have now been stable for a long period of time (Muskovich & Haag-Dawoud, 2012). The restriction of zero tolerance when driving (ZTD) means that, although the persons concerned may consume some alcohol, the extent of their drinking is monitored by hair analysis, and they may drink no alcohol at all before driving – zero tolerance with a blood alcohol concentration of 0.00 promille. If excessive alcohol consumption is demonstrated, they are no longer considered fit to drive and will be disqualified. Two further projects confirmed that hair analysis is more reliable than the traditional blood biomarkers for, on the one hand, testing and monitoring long-term abstinence from alcohol and, on the other, demonstrating chronic excessive alcohol consumption (Liniger, Nguyen, Friedrich-Koch, & Yegles, 2010; Wick, Keller, & Menn, manuscript in preparation).

Aims

The present study was also a substudy of the IRM UZH research package. The aim was to address the question of how alcohol problems are diagnosed. Do the medical experts actually make alcohol-specific diagnoses in the expert reviews and, if so, do they use the official diagnostic code? What is the role of EtG hair analysis in the assessment of fitness to drive?

Material/methods

This study consisted of a retrospective data analysis. Data were obtained from the expert medical reports issued by the IRM UZH in the first half of 2011. In selecting the expert reports, we applied the following criteria: *(a)* inclusion of cases referred for expert medical review of fitness to drive by the traffic authorities, on suspicion of alcohol problems, *(b)* exclusion of cases where there was another reason for the referral (e.g. illness, medication, or drug misuse).

The final database consisted of 454 expert reports. To address the original questions, we extracted data on: (*a*) the result of hair analysis for ethyl glucuronide, (*b*) the outcome of the expert report, (*c*) the nature and duration of any restrictions recommended and (*d*) the main medical diagnosis relevant to traffic safety.

Results

Description of the study population:

Out of the 454 people undergoing review of their fitness to drive, 392 (86%) were men and 62 (14%) were women. The average age was 42 years (ranging from the youngest 17-year-old driver to the oldest aged 80). It was the first review in 252 (56%) cases. The other 202 (44%) motorists had already undergone between one and nine expert medical reviews of fitness to drive. EtG hair analysis was carried out as part of the expert review in more than 90% of cases (418 drivers). Medical reports from other doctors were obtained in more than 50% of cases.

Findings:

The outcome of the expert review regarding fitness to drive was positive in about 59% (266) of the 454 cases. In contrast, the department issued 41% (188) negative reports. If motorists who were found fit to drive and those considered unfit to drive are classified according to the EtG category (0-6 pg/mg = not detectable; 7-29 pg/mg = social drinker; ≥30 = excessive consumption (Schweizer Gesellschaft für Rechtsmedizin (SGRM), 2012)), we get the following picture (figure 1).

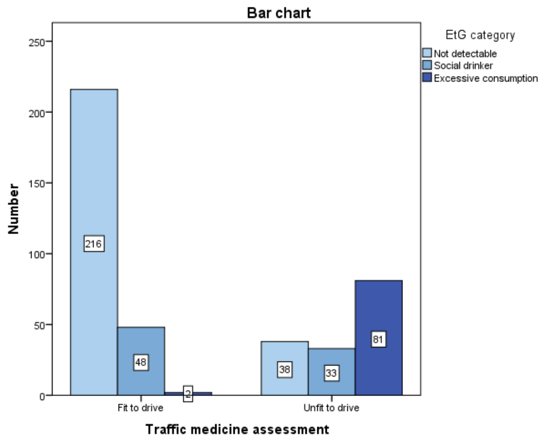

Figure 1: Bar chart showing fitness and unfitness to drive according to EtG category

An EtG concentration in the excessive consumption range usually led to motorist being disqualified from driving. In two cases, an expert report upholding fitness to drive was issued despite an EtG concentration ≥30 (the levels of 31 and 36 pg/mg in these two drivers being in the range of excessive consumption but only just above the limit for social drinking). As mentioned previously, no hair analysis for EtG was performed in 36 cases. The findings on all of these motorists had already indicated that they were not fit to drive. No alcohol metabolites were detected in the hair in one quarter of those whose fitness to drive was not upheld.

Even during data collection, it could be seen that the official traffic medicine diagnostic code (Seeger, 2005, pp. 25/26) had not been the sole basis for diagnosis at the IRM UZH. Looking more closely at the data obtained, the following diagnoses were made in the expert reports: (1) alcohol misuse relevant to traffic safety, (2) excessive alcohol consumption relevant to traffic safety, (3) risk of alcohol misuse relevant to traffic safety, and (4) alcohol dependence. In addition, no diagnosis related to alcohol consumption was made from a traffic safety perspective in more than one-fifth of the cases. Table 1 gives details of the diagnoses.

Table 1: Table showing the traffic medicine diagnoses with respect to alcohol consumption

Diagnosis	**Number**	**Percentage [%]**
No specific alcohol-related diagnosis	96	21
Alcohol misuse relevant to traffic safety	132	29
Excessive alcohol consumption relevant to traffic safety	135	30
Risk of alcohol misuse relevant to traffic safety	32	7
Alcohol dependence	59	13
Total	**454**	**100**

Out of the 266 people whose fitness to drive was upheld, five motorists did not have any alcohol-related restrictions added to their driving licences. 214 persons were required to maintain a total abstinence from alcohol (TAA) and 47 persons were given a period of controlled drinking with zero tolerance when driving (ZTD), as shown in table 2.

Table 2: Table showing the alcohol-specific restrictions imposed, according to duration of effect

Type of restriction	Duration of restriction					
	In accord. with internal guidelines	**½ year**	**1 year**	**1 ½ year**	**3 years**	**Total**
Total abstinence from alcohol (TAA)	**190 (89%)**	**2 (1%)**	**5 (2%)**	**6 (3%)**	**11 (5%)**	**214 (100%)**
Zero tolerance when driving (ZTD)	**19 (40%)**	**5 (11%)**	**14 (30%)**	**9 (19%)**	**0**	**47 (100%)**
Total	**209**	**7**	**19**	**15**	**11**	**261**

Table 2 also shows the duration of the restrictions imposed. A large proportion of the TAA restrictions were made in accordance with the internal guidelines, although there were a few deviations in the duration of effect. The duration of the TAA restriction was either shortened or lengthened. The length of time imposed for ZTD restrictions was, however, inconsistent.

Discussion and conclusions

The study showed that expert reviews carried out in our institute always gave a clear assessment of fitness to drive and defined the nature and duration of any restrictions to be imposed. The precise diagnosis, however, showed considerable inhomogeneity, and more diagnoses were made than are covered by the official diagnostic code. The internal guidelines were not always followed when restrictions were imposed.

From these findings, we concluded that we needed to reconsider the current practice in traffic safety diagnosis. The clear necessity for action prompted us to establish an in-house working group, which is even now revising the diagnostic criteria and evaluating a new diagnostic coding. Experience has shown that the traffic safety diagnosis should not be based solely on hair analysis results but that all the factors of the traditional expert medical review (past medical history, current event, findings on examination, reports from other doctors, etc.) should also be included.

It has been proposed that the new diagnostic term to be used will be “alcohol problems relevant to traffic safety”. This will be subdivided into “moderate”, “moderately severe” and “severe”. Changes in diagnostic coding will also make it easier to impose restrictions uniformly with respect to their nature and duration, especially if the degree of severity is coupled with a mandatory procedure.

Based on our experience with hair analysis for ethyl glucuronide in the last five years, we can say that the introduction of this method has revolutionised routine traffic medicine. Thanks to hair analysis it is now possible for us to assess drinking habits and monitor adherence to total alcohol abstinence much better than before. It must be remembered, however, that the EtG concentration has to be interpreted with caution and must always be considered in the light of the overall assessment.

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Adolescents to Adults: A Long-term Study of Impaired Driving

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Abstract

Background
Alcohol and drug impaired driving continues to be a major public health and traffic safety issue. Few studies have followed a population- based sample from adolescence into mid-adulthood to study patterns of impaired driving across the lifespan.

Aims
(1) To report the overall rates of impaired driving in mid-adulthood in this sample of men, and (2) To compare the variation in self-reported driving after drinking or drug use based on different items to assess this behavior.

Methods
The data are from the fourth wave of the Buffalo Longitudinal Study of Young Men, population-based sample of adolescent men originally recruited at ages 16-19. The initial study followed them into early adulthood (19-22 years of age) through waves 2 and 3. Wave 4 was instituted approximately 13 years later to examine impaired driving as the respondents aged into mid-adulthood (age 32-37 years). Wave-4 data consists of telephone interviews conducted by trained researchers and self-administered questionnaires that covered a broad range of topics. The follow-up rate for wave 4 exceeds 80% of the 602 living respondents. Several items were used to assess alcohol-impaired driving, alcohol and drug impaired driving, and drug impaired driving for the 12-months prior to the interview.

Results
For the item assessing driving within two hours of drinking, 49.4% reported this behavior. For the item assessing driving while feeling the effects of alcohol, 36.2% reported this. For the item assessing driving after having perhaps too much to drink, 25.4% reported this behavior. For driving while feeling the effects of a drug other than alcohol, 19.6% reported this, and 10.7% reported driving while feeling the effects of alcohol and another drug while driving.

Discussion and conclusions
Impaired driving continues at high rates into mid-adulthood. Driving while feeling the effects of alcohol at mid-adulthood substantially exceeded the 20% rate reported in late adolescence by the same sample. The items used to measure alcohol-impaired driving obtain significantly different estimates that decrease as the level of implied impairment increases. Drug-impaired driving occurs at a much lower, but still substantial rate. Future research will examine complex longitudinal models to identify specific factors associated with the continuation of impaired driving into mid-adulthood.

Introduction

Alcohol and/or drug impaired driving has a major impact on health and traffic safety throughout the world (World Health Organization, 2009). In the United States alone there are more than one-million arrests for impaired driving and over 10,000 alcohol-related traffic deaths each year (Department of Justice, 2012, Department of Transportation, 2012). The main focus of most research on alcohol and drug impaired driving has been on driving performance impairment, basic descriptive epidemiology (especially of offenders), prevention (primarily through general and specific deterrence), sanctions, and treatment. Longitudinal studies of impaired driving behaviors are highly limited (Moan et al., 2013). Few studies have examined a population- based sample from adolescence into mid-adulthood to study patterns of impaired driving across the lifespan. This study examines the prevalence of alcohol impaired driving across four waves of data collection in a population-based sample of men. The initial three waves of data were from the late adolescent-young adult time period (ages 16-22 years), with wave four being collected in adulthood (ages 32-37).

Aims

(1) To report the overall rates of impaired driving in mid-adulthood in this sample of men, and (2) To compare the variation in self-reported driving after drinking or drug use based on different items to assess this behavior. The first three waves of data have only a single measure of alcohol impaired driving, whereas the fourth wave has multiple measures of alcohol-impaired driving and multiple measures of drug impaired driving. These measures will also be assessed across racial groupings.

Methods

The Buffalo Longitudinal Study of Young Men is comprised of total of 625 males aged 16-19 in 1991-1992. The sample was only young men because the initial project focused on factors associated with longitudinal variation in criminal behaviors during the transition from adolescence to young adulthood. The participants were recruited from the general populations and include an over-representation of higher risk youth. This was accomplished by screening for higher risk indicators (e.g., transience, lack of supervision, etc.) and always recruiting those individuals with these risks and recruiting those who did not screen as high risk at a lower probability. The sample is well-balanced racially, providing nearly equal proportions of Whites and African-Americans (49% white, 45% African-American, and 6% from other racial/ethnic backgrounds). The full socioeconomic range is represented, with a slight over-representation of lower socioeconomic backgrounds. A total of three waves of data were collected approximately every 18 months in the initial study that covered ages 16-22 years old. A long-term follow-up study (Wave 4) was undertaken in 2008-2012 with a main focus on impaired driving behaviors. A total of 486 of the original sample were recruited and interviewed for Wave 4, resulting in an 81% follow-up rate among those subjects still living (486/602). Those 486 subjects are the focus of the current study. More details about the methods are available in Zhang et al. (2011).

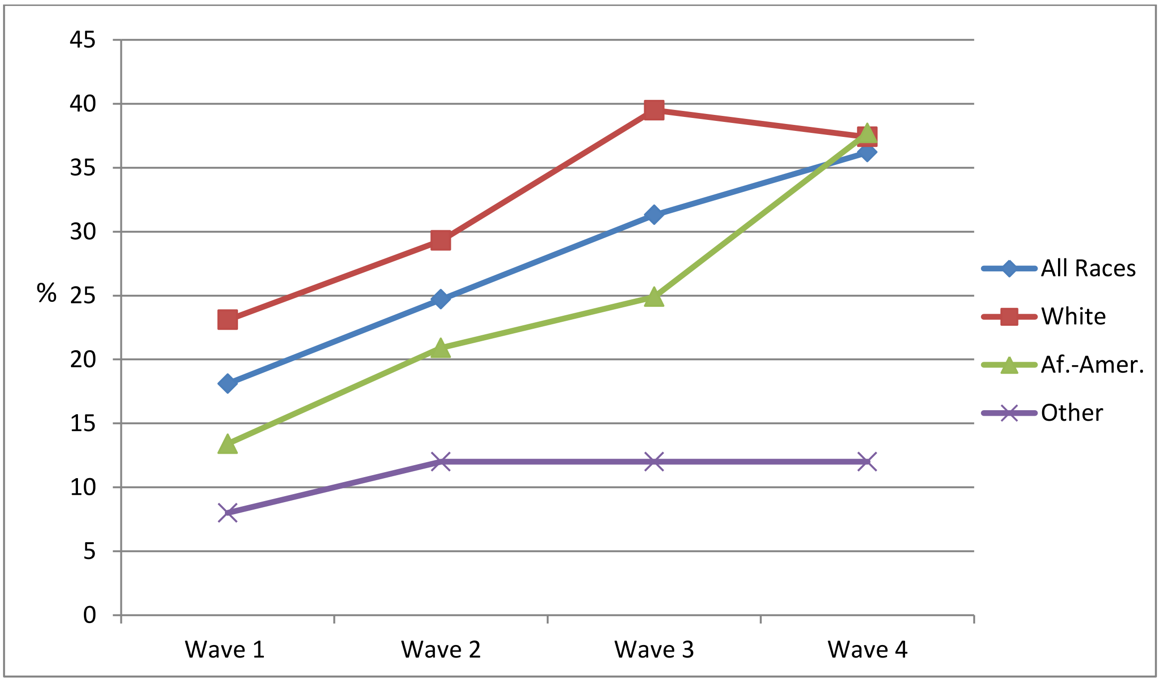
The keys measures are those of impaired driving behaviors. All of the comparisons in this study are based on 12-month prevalence rates for drinking and/or drug impaired driving. The item from the initial three waves and included in Wave 4 is from Elliott et al. (1985) is: “In the last 12 months, how many times have you driven a motor vehicle while feeling the effects of alcohol?” To assess a broader range of survey items on potential alcohol-impairment, the following alcohol-specific items were included in Wave 4. In the last 12 months, how many times have you (each is a separate item): Driven within two hours of drinking; Driven within four hours of drinking; Driven when perhaps had too much to drink.

To assess drug impaired driving, these measures were also assessed at Wave 4. In the last 12 months how many times have you (each is a separate item): Driven within one hour of using any drug other than alcohol; Driven within four hours of using any drug other than alcohol; Driven while feeling the effects of any drug other than alcohol, Driven while feeling the effects of alcohol and any other drug simultaneously. All of the alcohol and drug impairment items were turned into prevalence rates for these analyses. Note that the cross-tabulations for these analyses were statistically significant at the $p < .05$ level.

Results

The racial distribution of the Wave 4 sample was 49.4% White, 45.4% African American, and 5.3 other races, which is quite similar to the original sample. Figure 1 shows the longitudinal variation in alcohol impaired driving (feeling the effects while driving) from adolescence when alcohol consumption was illegal for those under age 21 (Wave 1 ages 16-19) to when some of the sample was of legal drinking age (Wave 2 ages 17-21, Wave 3 ages 19-22) to mid-adulthood in Wave 4 (ages 32-37). Drinking and driving was much higher at Wave 4 than for the previous waves. Most notable is the increase in drinking-driving by African Americans at Wave 4. The African American rate is now slightly higher than that of Whites, which decrease slightly from Wave 3 rates. The mixed race group has had a substantially lower rate across all time frames.

Figure 1 Longitudinal prevalence rate of driving while feeling the effects of alcohol.



The prevalence of various drinking-and-driving behaviors for Wave 4 is shown by race in Table 1. The simple measure of any driving within two hours of drinking has notably high prevalence rates for all races, especially for Whites. As the level of impairment attribution increases from "feeling the effects" to "perhaps had too much" the prevalence rates tended to decrease. The rates for Whites and African Americans were not different, while the other racial category had a substantially lower rate. Over one-third of the entire sample and also for Whites and African Americans reported driving while feeling the effects of alcohol. At least one-quarter of Whites and African Americans reported driving after having too much alcohol in the past year.

Table 1 Prevalence of drinking-and-driving behaviors by race Wave 4 (ages 32-37).

Race (n)	Drove within 2hrs drinking	Drove feeling alc effects	Drove after too much alc
Overall (486)	49.4%	36.2%	25.4%
White (235)	60.4%	37.4%	28.5%
African-American (216)	42.3%	37.7%	25.1%
All Other (25)	36.0%	12.0%	4.0%

In general, the prevalence of drug-impaired driving was substantially lower than for alcohol impaired driving (see Table 2). African Americans had the highest rates of drugged driving compared to other races and the overall rate for each measure. Notably, over one-quarter of African Americans in the sample reported driving while feeling the effects of a drug. Unlike alcohol impaired driving, the shorter time frame (one hour) was associated with lower prevalence rates of drug impaired driving. The other racial category again had the lowest rates of drug impaired driving. The combined drug and alcohol driving impairment had the lowest rates, although about 1-in-10 reported doing this behaviour in the past year.

Table 2 Prevalence of drugged-driving behaviors by race Wave 4 (ages 32-37).

Race (n)	Drove within 1 hr drug use	Drove within 4 hrs of drug	Drove feeling drug effects	Drove w/both alc & drugs
Overall (486)	16.9%	21.0%	19.6%	10.7%
White (235)	12.8%	16.6%	13.6%	8.5%
African-American (216)	23.1%	27.0%	27.4%	14.4%
All Other (25)	4.0%	16.0%	12.0%	4.0%

Table 3 shows the prevalence of ever being arrested for an alcohol or drug impaired driving offense (DWI/DUI) by prevalence of drinking-and-driving at each wave. Clearly, starting early, such as being an underage drinking driver at Waves 1 and 2 and even at Wave 3, is associated with a higher risk of being a DWI/DUI offender. Slightly over 30% of the Wave 1 and 2 drinking drivers were later arrested for DWI/DUI. A much lower percentage of the Wave 4 drinking drivers reported ever having a DWI/DUI arrest. This suggests that there is substantial change in who are the drinking drivers across the waves of the study. A comparison of Wave 3 and Wave 4 drinking drivers (no table) showed that only 47% of those who reported drinking and driving at Wave 3 were still doing so at Wave 4.

Table 3 Arrest for impaired driving by prevalence of self-reported impaired driving.

Drove while feeling alc	Percent with DWI/DUI
Wave 1	30.7%
Wave 2	30.8%
Wave 3	27.1%
Wave 4	19.0%

Discussion and conclusion

The results of this study indicate that drinking-and-driving behaviors change substantially over a life development time span. These changes were not uniform across racial groups. The overall prevalence rate for drinking and driving between Wave 3 (ages 19-22) and Wave 4 (ages 32-37) increased for the sample as whole; however, this was mostly accounted for by an increase in the African American prevalence rate. Whites and other races had modest changes.

The various measures of drinking-and-driving behaviors at Wave 4 showed differences in overall prevalence rates with the rate decreasing as the amount of implied impairment increased. This appears to be a logical and justifiable difference between the measures. Researchers need to be aware that the choice of the drinking driving measurement item could substantially impact on the actual behaviour being measured. The patterns of drinking-and driving-behaviors by race were similar for all of the measures, with the possible exception of the rate for Whites driving within two hours of drinking (suggesting that Whites may have more light drinking episodes).

The drugged driving measures at Wave 4 showed an interesting pattern to the results. The drugged driving rates were substantially lower than the drinking driving rates, but were still a notable amount of the sample (range of 11%-21% for the entire sample). African Americans tended to have higher rates than other racial groups across all measures of drugged driving. Future research needs to examine the factors that are associated with this variation across racial groups.

An examination of drinking driving prevalence longitudinally by arrest history for DWI/DUI showed that early starters (Waves1-3) had higher arrest rates than those reporting drinking and driving at Wave 4. This finding suggested that there must be substantial turnover from late adolescence to mid-adulthood (Wave 4) in who were the drinking drivers, which was substantiated by the finding that fewer than half of those who reported drinking-driving at Wave 3 also reported it at Wave 4. This result suggests that developmental models of drinking and driving are likely to be complex and have multiple longitudinal trajectories.

There are some limitations relevant to the current study. The sample is men only, so it may not adequately capture these behaviors for women. Also, although the sample is from the general population, the procedure oversampled those screened to be at higher risk for criminal behavior. Nonetheless, the findings from this study provide highly relevant avenues for future research on alcohol and drug impaired driving across the lifespan.

Acknowledgements

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A follow up sample of first time drink driving offenders: How many drink drive post offence?

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Abstract

Background
Drink driving remains an important issue to address in terms of health and injury prevention even though research shows that over time there has been a steady decline in drink driving. This has been attributed to the introduction of countermeasures such as random breath testing (RBT), changing community attitudes and norms leading to less acceptance of the behaviour and, to a lesser degree, the implementation of programs designed to deter offenders from engaging in drink driving. Most of the research to date has focused on the hard core offenders - those with high blood alcohol content at the time of arrest, and those who have more than one offence.

Aims
There has been little research on differences within the first offender population or on factors contributing to second offences. This research aims to fill the gap by reporting on those factors in a sample of offenders.

Methods
This paper reports on a study that involved interviewing 198 first offenders in court and following up this group 6-8 months post offence. Of these original participants, 101 offenders were able to be followed up, with 88 included in this paper on the basis that they had driven a vehicle since the offence.

Results
Interestingly, while the rate of reported apprehended second offences was low in that time frame (3%), a surprising number of offenders reported that they had driven under the influence at a much higher rate (27%). That is a large proportion of first offenders were willing to risk the much larger penalties associated with a second offence in order to engage in drink driving.

Discussion and conclusions
Key characteristics of this follow up group are examined to inform the development of a evidence based brief intervention program that targets first time offenders with the goal of decreasing the rate of repeat drink driving.

Introduction

Alcohol use is a significant public health issue in Australia with major implications for road safety. In Australia, over the last decade between 2000 and 2010 on average some 1600 people died annually as a result of traffic accidents (Department of Infrastructure, Transport, Regional Development & Local Government, 2010) and more than a third of fatal crashes involve drivers or riders who have a Breath Alcohol Concentration (BAC) of 0.05 gms/100ml or greater (National Road Safety Council, 2010). A proportion of the general population have also admitted to avoiding arrest while drinking and driving (Watson & Freeman, 2007). While there has been research into the 'high range' and 'repeat' drink drivers, little work has been done to explore the characteristics of first time offenders. It is known that offenders typically are not first time drink drivers but rather 'first time apprehended', in that most have engaged in drink driving in the years leading to the first conviction (Wilson, Palk, & Sheehan, 2010).

This paper follows 88 first time drink driving offenders who were interviewed at the time of court mention and followed up 6-8 months following the court hearing. Of the offenders, 27% reported to have driven over the limit in the time between initial contact and follow up. The paper provides a brief overview of some key characteristics of first offenders who engaged in drink driving following conviction and those who didn't, providing suggestions on how to target those at high risk for the behaviour and subsequent offending.

Methodology

Participants

A sample of 88 first time drink driving offenders was obtained from a larger sample of offenders who had been previously interviewed at the time of court offence. These offenders had taken part in an interview directly following their court hearing for the first time offence in the Brisbane or Maroochydore Magistrates Court, in Queensland. These courts have assigned traffic offender hearings on specific days. Offenders provided consent to follow them up 6-8 months following the offence by phone or email.

Procedure

In the 6-8 months following the offence, participants were contacted by email or telephone and subsequently completed a brief questionnaire, either online or by phone interview, about their behaviours following the original index offence, including whether they had been apprehended for drink driving, or were drink driving without being apprehended.

Results

The data was analysed using the PASW Statistics 18 program for Windows. This was done firstly by examining frequency distributions, and then bivariate comparisons were made using chi-square analysis to identify differences between those who self reported drink driving at follow up and those who didn't. Ordinal variables were measured with the linear-by-linear option. Key variables were derived from the initial interview with offenders, which included demographics, offence information, and risky alcohol use as measured by the AUDIT questionnaire. The AUDIT is a measure of harmful alcohol consumption, and has been validated in a study using patients from six countries (World Health Organisation). As per the guidelines, a cutoff score of 8 or more is used in this study to indicate a strong likelihood of hazardous or harmful alcohol consumption.

Of the 101 offenders in the follow up, 88 are used in subsequent analyses of data (on the basis that they had reported driving a vehicle in the last 6 months). While it appears a high number had not driven in the 6-8 months post first offence, the period of licence disqualification for some offenders was larger than the period of follow up. Of the sample of 88 offenders, 27% of offenders self reported drink driving in the follow up period. Within the same time frame, only 3% reported that they had been apprehended for an offence. The following results provide comparative information about the offenders who self reported drink driving (27%) compared to the rest of the sample who reported no drink driving in the follow up period (73%).

Table 1 below provides demographic information about the offenders who self reported drink driving compared to the rest of the follow up sample.

Table 1: Demographics of follow up sample of first time drink driving offenders who self reported drink driving compared to those who did not self report drink driving

Demographic characteristics and self reported drink driving in the 6 months post conviction		
	No	Yes
Gender		
Male	47 (73.5%)	20 (83.0%)
Female	17 (26.5%)	4 (17.0%)
Age groups		
17-25	28 (43.8%)	15 (62.5%)
26-39	26 (40.6%)	6 (25.0%)
40+	10 (15.6%)	3 (12.5%)
Level of education		
Year 10	9 (14.1%)	5 (20.8%)
Year 12	25 (39.1%)	10 (41.7%)
Cert/Diploma	16 (25.0%)	6 (25.0%)
Bachelor/Postgraduate	14 (21.8%)	3 (12.5%)
Marital Status		
Single	39 (60.9%)	17 (70.8%)
Married/de facto	22 (34.4%)	5 (20.8%)
Other (div, sep, wid)	3 (4.7%)	2 (8.4%)
Employed		
No	14 (21.9%)	5 (20.8%)
Yes	50 (78.1%)	19 (79.2%)

The data showed a trend in the expected direction, in that the majority of those who self reported drink driving were male, young, educated, single and employed. However, there were no significant differences between self reported drink driving and the demographic characteristics. It must be noted that the small sampling population may be a reason for non-significance in this instance.

Table 2 shows other key characteristics of offenders at first conviction, including driving history, BAC level, method of apprehension, and alcohol use as measured by the AUDIT questionnaire.

Table 2: Other key characteristics

Driving history, BAC, apprehension and alcohol use and self reported drink driving in the 6 months post conviction		
	No	Yes
Driving history		
Up to 5 years*	13 (20.3%)	11 (45.8%)
5-10 years	18 (28.1%)	4 (16.7%)
10+ years	33 (51.6%)	9 (37.5%)
BAC when apprehended		
0.01-0.05	3 (4.7%)	1 (4.2%)
0.051-0.10	38 (59.4%)	16 (66.7%)
0.101-0.15	18 (28.1%)	5 (20.8%)
0.151 +	5 (7.8%)	2 (8.3%)
Method of apprehension		
RBT	50 (78.1%)	21 (87.5%)
Method of driving	14 (21.9%)	3 (12.5%)
Alcohol use		
Non-risky	21 (32.8%)	3 (12.5%)
Risky	43 (67.2%)	21 (87.5%)

The above table demonstrates the key characteristics examined for this report. The chi-square test of independence found that those offenders who self reported drink driving in the months following conviction were likely to have less driving experience X^2 (2, N = 88) = 3.82, p=0.051. There was also a trend which demonstrates that risky drinkers were more likely to engage in drink driving X^2 (1, N = 88) = 3.63, p=0.065. While not significant, the trends are in the expected direction.

Conclusions

There are a number of participants in the current study who continued to drink and drive following their initial drink drive offence and court appearance. There was little evidence of differences between demographic characteristics of those who continued to drink and drive and those who didn't. This research demonstrated that within a defined geographic area a significant number of participant offenders (27%) admitted to engaging in drink driving in the 6 months post index offence, and of these offenders, those with a limited driving history under 5 years were the most at risk of drink driving. Risky drinking also clearly contributes to subsequent drink driving. The study used a small sample size therefore results should be interpreted as such. Should these results be replicated in future studies especially across a broader geographic areas and with higher participant numbers there will be implications for both criminal justice and health. The use of alcohol ignition interlocks may be indicated for early convicted drink drivers, and the reduction of drinking for 'at risk' offenders may be a way to decrease subsequent drink driving. In terms of developing an intervention program targeted at first offenders, one key component should be addressing risky alcohol use.

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The feasibility, delivery and cost effectiveness of drink driving interventions: A qualitative analysis of professional stakeholders

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Abstract

Background: Drink driving remains a pertinent road safety issue. As such, many countermeasures continue to be developed in order to reduce the number of drink drivers on the road. Many intervention programs have been designed to decrease the rate of drink driving by altering the behavioural characteristics that may lead a person to drink and drive. However, most programs target high risk and repeat offenders. There is very little research on the feasibility and effectiveness of first offender programs. **Aims**: This project is part of a larger program of research that focuses on first time offenders, in order to reduce the rate of subsequent drink driving which may result in a repeat offence. **Methods:** A number of professional stakeholders were approached and interviewed with a view to capturing and reflecting current drink driving related concerns while developing an intervention in the context of Australian drink driving related legislation. The qualitative interviews involved open ended questioning which led to the themes discussed in the analysis. Included in the interviews were senior representatives from the Magistrates Court, Queensland Transport, Probation & Parole, Queensland Corrective Services, Royal Automobile Club Queensland (RACQ), Intraface Consulting (drug & alcohol EAP), Brisbane Police Prosecution Corps, Queensland Police Service and private practice psychology. Issues such as delivery of interventions, feasibility and cost-effectiveness were discussed, as were potential content and design. **Results:** It was generally agreed that a tailored online intervention imposed as a sentencing option would be the most effective for first time offenders in terms of cost, ease of delivery and feasibility. **Discussion and conclusions:** The development of an online intervention program for first offenders is widely supported by professional stakeholders.

Introduction

Intervention programs to curb drink driving have been on the increase worldwide as a response to the rate of fatalities and injuries to which drink driving contribute. With the wave of technology contributing to the development of new innovative intervention programs there has been a call for the development drink driving programs to cater for this need. Recent research has found that screening and brief intervention for alcohol use can reduce the rate of drink driving offences (Davis, Beaton, Von Worley, Parsons, & Gunter, 2012), while other research has shown that computerised alcohol interventions can be as effective as face to face alternatives (Butler & Correia, 2009; Elliott, Carey, & Bolles, 2008).

In this study, eight professional stakeholders from Queensland were interviewed to gain insight into what this proposed program would entail, including the positive aspects and potential barriers of developing such a program for drink driving offenders.

The themes of the stakeholder interviews were separated into three main groups: *intervention content, intervention design,* and *feasibility and cost effectiveness*. These were discussed in depth during the interviews, with key themes arising.

Intervention content

The stakeholder questions were designed to illicit information which would determine the content that could be used in a brief intervention program for first offenders. One element to emerge was that stakeholders favoured an intervention focussed on principal messages. This could be achieved by focussing on a few key take home messages integrated in the intervention. Reporting on the individual's behaviour and the possible harms, as well as educational messages such as standard drinks and reaction times, were seen to be of more importance than reporting on interesting facts such as money spent or weight gained by alcohol use. There was a call to have the intervention focus on mainly drink driving rather than alcohol use with the possibility of screening and referral for those with alcohol use issues.

The following analysis lists the key themes derived from the interviews relating to intervention content. Main suggestions for intervention content for a first offender sample were *standard drinks* (including information on differences in metabolising alcohol, and the current guidelines), *consequences of drink driving* (individual, social and legal) and *reaction times*.

Standard drinks

The first key theme when discussing intervention content was the improvement of education on standard drink measures. Most interviews covered the importance of educating individuals about standard drink measures, calculation of BAC according to gender and weight, and educating about the amount of time it takes for alcohol to be out of the metabolic system.

> "Educating the participant on standard drinks is an important component for this type of training."

While most stakeholders agreed that education regarding standard drinks was in the public arena, it was noted that many drink drivers were confused about how alcohol reacts with the body even if they have the intention to stay under the limit.

> "It's more about reaching them about the fact that... you can still have alcohol in your system hours later."

There was a call for improvement of the current guidelines to stay under the legal blood alcohol content. Interestingly, these are only guidelines and not rules, with most sources (cards, pamphlets etc) indicating "This is a guide only. Some people can manage less." The stakeholders felt as though this message wasn't getting through to offenders, particularly those who try to stay under the limit and are subsequently apprehended with very low readings for their licence type. Some suggestions for improvement included removing the ambiguity of the current guidelines, and offering revision on the current message to make it more specific, in that it doesn't apply to everyone.

> "Where the (standard drink) message removes... ambiguity, the driver may more readily understand they will calculate incorrectly and get caught."

> "Include a message to indicate if you've had a big night out, have a big day in."

Consequences of drink driving

The second key theme of the content questions was that first offenders need to be instructed on the possible impacts of drink driving for themselves and others. This included looking into all the possible consequences of the drink driving behaviour, and the possibility of discussing how individual risk can be quantified.

> "What are the likely impacts on families if there's an injury/fatality either to the person drink driving or to someone else involved in a crash as a result of drink driving?"

> "They need to understand... if they don't (stay under the limit) and they drive, what risks they are taking to themselves and others and how those risks can be quantified, for instance, the slowing down of reaction times..."

Reaction times

The third key theme relating to content was that individuals need to be educated on reaction times, as they may believe they are safe to drive but be putting themselves at risk. It was generally agreed that most drink drivers either do not think about the possibility of their reaction time being slowed, or believe that it is not the case.

> "The slowing down of their reaction times, their reduction in observation ability... they are the most important things."

Intervention design

In terms of intervention design, it was suggested that the key factors above be formed into modules that can be tailored to individuals and delivered in the most effective manner. Discussions about design focussed on *interactivity, attention to content,* and *tailored feedback.*

Interactivity

The majority of stakeholders agreed that when using a computer based intervention, interactivity is the key. The main comment was that the program should not be presented in just information form (for example, by PowerPoint presentation) or too game like, but should contain components of both merged in an interactive fashion.

> "An interactive presentation would keep the participant interested and they would retain more of the information if they were able to participate interactively."

> "I would want them to be interacting with actual scenarios, real life stuff online, like games."

Attention to content

There was also the common suggestion that offenders should be given questions throughout the session or at the end to encourage learning and attention to the content.

> "If it's interactive and you are recording the interaction, you already know. So if you can have some sort of interactive component of each section, then you know that they are paying attention because you have got the responses from their interaction."

Tailored information

There was discussion with all stakeholders regarding the usefulness of tailored information in a brief program for distinct groups such as low risk and high risk drink drivers.

> "Perhaps there could be a referral for more detailed treatment/counselling or even further education available after completion of the online program... basically; that its matching low risk, low risk interventions; high risk, high risk, intensive interventions."

Secondly, personalised feedback was seen to be an important component of an intervention for first offenders. It was suggested that this would act as a key factor in retaining information and assisting the learning process. It was noted that during any feedback, there should be a component where it is reminded that the participant has access to rehabilitation and support networks, and these should be listed. The concept of tailoring feedback to the individual was highly regarded by all the stakeholders.

> "Effective feedback would include confirming and repeating for the driver any information they provide which acknowledges the key elements of the message, demonstrates an acceptance for their actions, and identifies an understanding they have to change their patterns and decision making process."

Feasibility and cost effectiveness

Web based interventions potentially provide a cost effective method of intervention delivery to large numbers of first time drink driving offenders.

Online intervention

It was generally agreed that online intervention would be the best in terms of cost effectiveness and feasibility. This would also the program to cover a broader range of people, although it takes from the value of face to face individual intervention (such as counselling or group work). There was extensive discussion about the efficacy of online intervention and cost effectiveness.

> "Online would probably be fairly cost effective and able to reach everybody around Queensland... It's got to be state-wide... online would probably be the most simple way of doing that and cost effective as well."
>
> "You could get more personalised sort of answers from them and get more information from them using that (internet) delivery as opposed to having a classroom-based thing because people aren't always going to want to share their personal situation..."
>
> "We supported the idea of it being mandatory. Online is probably the cheapest way to do it."
>
> "I wouldn't suggest that you discount the value of having a mandated program coupled with conditions. I think this is probably going to be a very cost effective way of delivering the program, compared to group programs."
>
> "You are going to have the consistency, the program integrity and certainly the cost effectiveness which are good arguments for computer based training."

Timing

There was discussion regarding the timing of the intervention, and there were suggestions that the program be undertaken prior to the court hearing, or prior to relicensing. In terms of the process of either method, there would be different processes involved.

> "If it was pre-court, they would have to pay to get into the course and it may be given credit or be held in mitigation on the final sentence of the court."
> "It could be ordered by the court as part of a community based order, which is what happens now with the drink driving program."

There was also mention that the program may be effective as a preventative program, prior to any offences taking place. This was discussed by two stakeholders in comparison to the current Learner driver program, where a package is sent to drivers to educate them about factors relating to driving. They suggested that the intervention should be completed firstly as a preventative approach whereby all new drivers must complete the program.

> "The computer based package should be available to all drivers, not just first time drink drivers as there are a significant number of people who are not detected though continue to drink drive."
> "Maybe there's some justification for running this program which is a very shortened individual intervention program, prior to them being convicted of drink driving."

Method of Entry

Regardless of the process of either method of delivery (before court or after), there were suggestions as to how these processes may be carried out in the most successful manner.

> "Get the courts to impose it as part of the sentencing operation and maybe as an offset they could reduce the amount of disqualification by a shorter period... what we are doing is giving the magistrate another sentencing option."

Conclusion

The findings of the study suggest there is a potential for a brief computer based program designed to target first time convicted drink drivers. The proposed program should provide education about the harms of drink driving, the calculation of BAC levels, and standard alcohol beverage size as well as information about the effect of alcohol on reaction times. Providing this information via an online web based program appears to be a cost effective way to target a number of first time convicted drink drivers.

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