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A targeted review of the links between blood alcohol limits, alcohol sales and advertising on road trauma

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Abstract:

The Royal Automobile Club (RAC) of Western Australia contracted the Curtin-Monash Accident Research Centre (C-MARC) to provide a critical review of the relevant literature on the links between blood alcohol limits, alcohol sales and advertising on alcohol-related road crashes. The aims of the review were 1) to document the effects of lower (less than the current legal 0.05 % BAC) doses of alcohol on road user performance and behaviour; 2) to document the effects of low doses of alcohol on road crash rates and outcomes; and 3) to review national and international published research studies linking the influence of alcohol trading hours, sales, and advertising on road crash rates and outcomes.

Based on the literature review, it is concluded that alcohol related crash risk and the associated costs are significant and ongoing road safety issues in Australia. With the successful adoption of zero BAC limits for learner and probationary drivers/riders across Australia, it may now be an opportune time to consider a longer term solution: to extend the zero BAC legislation for all drivers into their full licence period. Such a solution would only be effective, however, if the public were supportive of such legislation and if it was effectively enforced. Further research into appropriate social marketing messages would be needed before such restrictions could be put in place.

Key Words:
Alcohol, crash risk, drink driving, BAC, alcohol advertising, alcohol sales, zero BAC, extended trading hours

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Preface

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Funding for the project and guidance on the direction of the research was provided by Mike Lenné and Brett Hughes.

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Ethics Statement

Ethics approval was not required for this project.

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EXECUTIVE SUMMARY

Introduction

The relationship between alcohol consumption and road crashes is well recognized. In Australia, alcohol is involved in one third of all road deaths; with at least one in four fatal crashes involving drivers with a BAC over the legal limit. In Western Australia during 2009 one third of all fatal crashes involved a driver with a blood alcohol content (BAC) over the legal 0.05g/100ml (0.05%) limit and more than half of these drivers were three times over the legal limit.

Alcohol consumption of even low quantities has been found to affect a driver's reaction time, balance and their ability to accurately judge speed and distance, all of which are important skills in safe road use. Novice drivers with less driving experience and skill development have the highest crash risk associated with alcohol. In particular, young males represent the highest alcohol related crash risk group of all driving populations. Further, alcohol impaired drivers are more likely than non-impaired drivers to engage in other high risk driving behaviours such as speeding and not wearing seatbelts.

Various strategies have been implemented in attempts to address alcohol related crash fatalities and serious injuries. These include, for example: legislation of driver BAC limits including zero BAC limits for novice drivers; targeted and Random Breath Testing (RBT) on a large scale from booze buses and on a smaller scale from car based activities; and mandatory drink driving sanctions including interlocks for repeat drink driving offenders.

Alcohol availability times are on the increase with the trend to extend the trading hours of takeaway alcohol sales outlets and late night entertainment venues. Alcohol sales are further promoted by the alcohol industry through the extensive use of high budget advertising. The effects of increased alcohol promotion and availability on drink driving and alcohol related crash risk remains under researched.

The aim of this research report was to review the links between blood alcohol limits for vehicle controllers (e.g., drivers, riders), alcohol sales and advertising on road trauma. An ultimate output of this work is a comprehensive literature review exploring:

- The effects of lower doses of alcohol, less than the current legal 0.05 % BAC level, on road user performance and behaviour;
- The effects of low doses of alcohol on road crash rates and outcomes (such as the number of people killed and/or seriously injured); and
- National and international published research studies linking the influence of alcohol trading hours, sales, and advertising on road crash rates and outcomes.

Alcohol and crash risk

Legislation that defines a jurisdiction's maximum BAC limits varies internationally ranging from 0.08% in the US, the UK, Canada and New Zealand, to zero in Romania, Brazil and Armenia. Australia has adopted a uniform 0.05% BAC limit for full licence holders and, more recently, a zero BAC limit for learner and probationary licence holders. There is strong evidence that high level alcohol consumption impairs driving ability and leads to heightened crash risk. Research quantifying the degree of impairment in relation to

various BAC levels, and low BAC levels in particular, as well as the degree of precise impairment relevant to increased crash risk, remains inconclusive. However, there is growing empirical support for both the presence of impairment and increased alcohol related crash risk for any positive BAC level above zero.

Alcohol is involved in approximately one third of all fatal road crashes in Australia. Young road users are overrepresented in these crashes with young males aged 25-39 representing the highest fatal and serious injury crash risk group followed by males aged 17-24. Many Western Australian drivers complete their zero BAC probationary licence restrictions by 19 years of age, a high risk age for alcohol related crashes. Alcohol impaired pedestrians also represent a high crash risk, especially when they travel home from entertainment venues. Other factors such as fatigue and distraction interact with the effects of alcohol, further impairing driving performance. More research is required to explore and quantify the co-contribution of these other factors on alcohol related crash risk.

Alcohol involvement in crashes remains underreported. This underreporting has been attributed to ongoing problems associated with BAC testing of crash involved motorists, especially those involved in casualty crashes. BAC data is essential not only to provide an accurate representation of the extent of alcohol related crash involvement, but also to monitor or evaluate drink driving enforcement efforts and other countermeasures. The reporting of crash involved driver BACs needs to be explored with the aim of identifying current reporting rates, including any biases in obtaining BAC readings from crash involved drivers.

Alcohol sales

Although there is limited data available specifically exploring the relationship between alcohol sales and crash risks, the relationship between alcohol sales and road trauma has long been recognised within the road safety field. Alcohol sales data are regularly used as a predictive factor in crash modelling. Increased availability of alcohol is associated with increased incidence of harmful alcohol consumption. Research into extended trading hours in venues in inner Perth, WA, identified that extended trading practices (ETP) venues are predominately located in inner city areas, target a younger aged (e.g., 19-29 yrs) patron, and sell large quantities of mostly high alcohol type beverages. Increases in alcohol impaired crashes have been found to be associated with these ETP venues. The targeting of younger males by ETP venues, combined with the pre-existing higher crash risks associated with these younger, novice drivers, creates a situation where this group of drivers is at an even higher compounded crash risk. To improve overall road safety, it is this group of drivers who, rather, should be discouraged from attending these venues.

Alcohol Advertising

Alcohol advertising plays two diverse roles in relation to drink driving. First, the flow on effects from alcohol advertising that endorses or creates a social culture that promotes alcohol consumption can make it difficult for vulnerable populations to separate their drinking and driving behaviours. Second, advertising has been used in road safety campaigns to highlight the risks associated with alcohol consumption and driving, in attempts to deter drink driving behaviour.

Direct alcohol advertising is widespread across Australia; for example, through newspapers, television, billboards, and on-line. However, more covert advertising has been achieved through product placement, sporting sponsorship, and the portrayal of popular media role models consuming alcohol. In Australia, alcohol advertising content is regulated by the Alcoholic Beverages Advertising Code (ABAC); however, the effectiveness of this self-regulatory code has been questioned. The most commonly identified breach relates to the portrayal of alcohol consumption resulting in increases in positive social or sexual experiences. The screening times of alcohol advertising on free-to-air television is regulated under the Commercial Television Industry Code of Practice. Research into television alcohol advertising in Australian capital cities revealed that 38% of weekend alcohol advertising was broadcast in the daytime during the restricted 5 a.m. - 8:30 p.m. time frame; however, this was not considered to be in breach of the regulations because of the "*accompanying a live sporting broadcast*" clause.

Although methodological challenges make the effects of alcohol advertising difficult to measure, it is recognised that young people are more sensitive to advertising and that a lifelong exposure to both direct and covert advertising places young people at greater risk. Suggested countermeasures to alcohol advertising include alcohol advertising bans, as well as partial or full media based public education campaigns.

Enforcement

Police enforcement plays a key role in the detection of drink drivers and in the prevention of alcohol related crashes through both general and specific deterrence strategies. Research shows that one's perception regarding the likelihood of being detected for drink driving is a key factor in the decision to refrain from driving when over the legal BAC limit. A focus on enforcement strategies is important to ensure their continued effectiveness in deterring and detecting drink driving, especially during the current climate of changing social drinking patterns (such as ETP venues) and attitudes (online alcohol advertising) toward drinking behaviour. In Australia, drink driving is viewed as a serious and high risk illegal driving behaviour and mandatory sanctions have been legislated to reflect the seriousness of the problem. The majority of drink drivers go undetected; however, with research also indicating that one third of drivers convicted for drink driving will repeat offend. Repeat offenders, the majority of whom are males aged 25 years and under, are 2.3 times more likely to be involved in a crash compared to the non-drink driving population.

Although it is well recognised that a considerable proportion of drink drivers go undetected and that one's perception of being detected plays a key role in the decision to drink drive, research is rarely undertaken to evaluate RBT effectiveness with the aim of informing intelligence based RBT resource allocation and scheduling. The majority of drink driving enforcement and detection activities occurs through the deployment of booze buses. These highly visible buses allow for the random testing of high proportions of drivers in a safe environment for the police and motorists, with minimal disruption to traffic. Typically, car based RBT is used for intercepts (targeted enforcement) rather than scheduled RBT sites; however, research from New Zealand has identified a pattern among drink drivers to detour off main roads and on to local residential streets in attempts to avoid detection.

With the increased availability of alcohol purchasing outlets outside of normal trading hours, through both takeaway alcohol outlets and extended trading hours venues, it is important to maintain the perception of a high chance of detection for drink driving. Research into the introduction of ETP found that the increased crash rates associated with higher alcohol sales were moderated by the placement of booze buses on freeway travel routes surrounding venues that had been granted ETP licences. Highly visible drink driving enforcement practices should be explored as a crash prevention strategy in relation to late night drinking venue localities.

Geographical data suggests that the density of licensed entertainment venues is associated with the prevalence of drink driving. With the expansion of extended trading hours it is important that research is undertaken in Western Australia to explore the effects of these alcohol sales hours on drink driving patterns within both metropolitan and rural areas. This information is invaluable in ensuring that RBT resources are targeted to maximise cost benefits. Intelligence based RBT scheduling should be a priority and should focus on both the highly visible booze bus operations to maximize general deterrence benefits, as well as car based operations to address any growing perceptions that RBT sites are predictable and can be avoided.

Based on the findings of the literature review specific recommendations are made in relation to: further research; data collection, linking and analysis; alcohol advertising; and enforcement (see Section 4 of this report).

Conclusion

The relationship between alcohol consumption, driver / rider impairment, and crash risk is well recognised. Although the debate regarding the degree of impairment corresponding with specific BAC levels is ongoing, particularly for low BAC levels, this should be viewed as fine tuning rather than questioning the fundamental relationship. Within the road safety field, pharmacological developments leading to improved accuracy in BAC testing have provided the opportunity to further explore the appropriateness of current legal driving BAC limits. Research using both simulated and naturalistic methodologies to explore alcohol impairment across various driving / riding populations, as well as the effects of co-contributing factors such as age, gender, fatigue and distraction, continues to provide empirical evidence to guide policies and legislation surrounding alcohol consumption and road users.

There is a growing trend across Australia to extend alcohol purchasing hours through increases in the numbers of takeaway outlets and ETP venues. The effects of increased alcohol trading hours on drink driving and alcohol related crashes require ongoing monitoring and empirical evaluation. Further, alcohol sales are promoted through extensive, high budget advertising. The amount of advertising and degree of exposure necessary to result in an increase in alcohol consumption is difficult to calculate empirically. However, research claiming that alcohol advertising results in increased alcohol consumption, especially amongst high risk groups such as young males, exists. The effectiveness of alcohol advertising bans and public education campaigns as countermeasures to alcohol advertising warrants further investigation.

While the majority of drivers comply with drink driving legislation, drink driving continues to represent a significant road safety problem. Drink driving enforcement initiatives need to be intelligence based. Random breath testing data should be explored for its relevance and comprehensiveness in facilitating the ongoing monitoring and evaluation of drink driving patterns and trends.

Alcohol related crash risk is a significant and ongoing road safety issue. The associated costs, direct and indirect, financial and emotional, are considerable. The successful adoption of zero BAC limits for learner and probationary licence holders, across Australia, has resulted in a generation of young drivers who have a high acceptance of, and adaptation to, the necessity of separating their driving behaviour from their alcohol consumption behaviour. Perhaps now is an opportune time to consider whether a long term solution to the drink driving and alcohol related crash risk problem would be to extend the zero BAC legislation for this cohort of drivers until they reach the lower alcohol related crash risk age group (30 or 40 years) or perhaps even indefinitely across their entire driving years.

1. INTRODUCTION

1.1 OVERVIEW

The Royal Automobile Club (RAC) of Western Australia has contracted the Curtin-Monash Accident Research Centre (C-MARC) to provide a critical review of the relevant literature on the links between blood alcohol limits, alcohol sales and advertising on alcohol-related road crashes.

1.2 PROJECT AIMS AND OBJECTIVES

An ultimate output of this work is a comprehensive literature review exploring:

- The effects of lower doses of alcohol, less than the current legal 0.05 BAC level, on road user performance and behaviour;
- The effects of low doses of alcohol on road crash rates and outcomes (such as the number of people killed and/or seriously injured); and
- National and international published research studies linking the influence of alcohol trading hours, sales, and advertising on road crash rates and outcomes.

The review provides a concluding statement on the robustness of the work conducted to date, and future directions that should be explored to achieve greater gains in this area. C-MARC understands that this information will be used by the RAC as background information for a discussion paper for members and stakeholders.

1.3 OUTLINE OF THIS REPORT

The literature review commences with a focus on the relevant literature regarding the effects of low doses of alcohol (i.e., those under the legal limit of 0.05% BAC) on driving performance and crash risk. Secondly, literature is explored that pertains to the increasing availability of alcohol, such as through extended trading hours, and its relationship to increases in alcohol consumption, drink driving and alcohol involved crash risk . The third phase of the literature review concentrates on the available research on alcohol advertising to investigate any documented links between increased alcohol consumption and alcohol related crashes. Finally, a section on enforcement is included, in recognition of the key role that enforcement plays in deterring drink driving behaviour. A summary of the findings from all four sections is provided, followed by recommendations informed through the overall literature review process.

2 LITERATURE REVIEW

"Alcohol-impaired driving is a leading contributor to road traffic injuries and fatalities worldwide" (ICAP, 2010).

The relationship between alcohol consumption and road crashes is well recognised. In Australia, alcohol is involved in one third of all road deaths, with at least one in four fatal crashes involving drivers with a BAC over the legal limit (National Road Safety Council [NRSC], 2011). In Western Australia during 2009 one third of all fatal crashes involved a driver with a BAC over the legal 0.05g/100ml (0.05%) limit and more than half of these drivers were three times over the legal limit (ORS, 2011a).

Alcohol consumption of even low quantities has been found to affect a driver's/rider's reaction time, balance and their ability to accurately judge speed and distance, all of which are important skills in safe road use (Palm, Waitz, Strobel, Metrikat, Hay, & Friemert, 2010). Throughout this report the term driver will collectively refer to both car drivers and motorcycle riders unless otherwise stated.
Novice drivers with less driving experience and skill development are at the highest risk for alcohol related crashes. Young males represent the highest alcohol related crash risk group of all driving populations; a finding that is often attributed to a false sense of confidence resulting from their alcohol intake (Cause, Kouabenan & Delhomme, 2004). Alcohol impaired drivers are more likely than non-impaired drivers to engage in other high risk driving behaviours such as speeding and not wearing seatbelts (TAC, 2011).

Various strategies have been implemented in attempt to address alcohol related crash fatalities and serious injuries such as: legislation of driver BAC limits including zero BAC limits for novice drivers; Random Breath Testing (RBT, such as booze buses and car based sites) enforcement strategies; and mandatory drink driving sanctions.

Alcohol availability times are on the increase with the growing trend to extend the trading hours of alcohol sales takeaway outlets and late night entertainment venues. Alcohol sales are further promoted by the alcohol industry through the extensive use of high budget advertising however, the effects of increased alcohol promotion and availability on drink driving and alcohol related crash risk remains under researched.

2.1 ALCOHOL AND CRASH RISK

In 2006, over a quarter of all fatal road crashes in Western Australia involved a driver / rider with a BAC of 0.05% or greater (Marchant, Hill, Caccianiga & Gant, 2006). Crash risk has been shown to have a direct relationship with BAC level. With a BAC of 0.05% a drivers crash risk is doubled; this risk is seven fold for a BAC of 0.08% and 25 fold for a BAC of 0.15 % (RTA, 2000).

2.1.1 BAC and impairment

While the effects of alcohol related impairment on driving / riding is well recognised, debate as to the BAC level at which impairment becomes a road safety issue continues. Typically, where driving BAC legislation exists, the adopted legal BAC levels range between zero to 0.08%. The legal driving BAC limit of 0.05% has been adopted Australia wide for full licence holders. BAC limits of 0.08% are legislated in the US, UK, New Zealand and Mexico, 0.05% in Australia, Germany and China (ICAP, 2010). Japan, Uruguay and India have set 0.03% with 0.02% in Sweden, Norway, Poland and Mongolia.

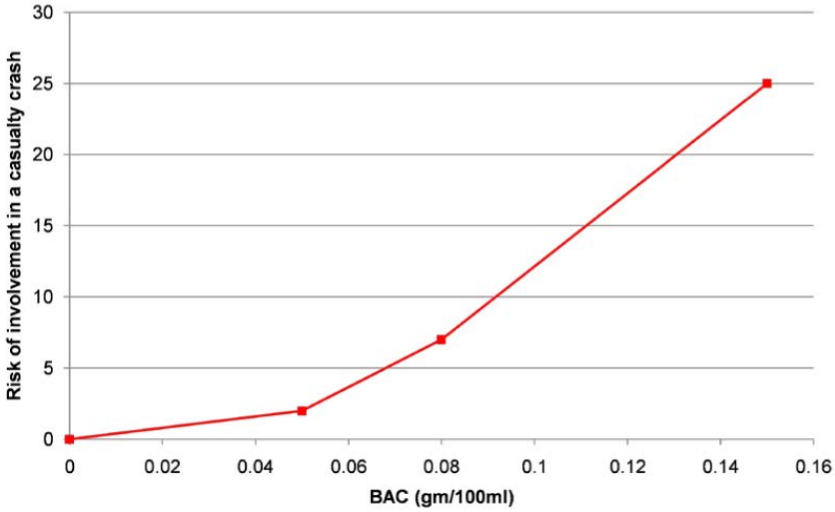
Countries such as Romania, Brazil and Armenia have adopted zero BAC limits (ICAP, 2010). In response to the recognised increased crash risks resulting from the combination of even low BAC levels and driver inexperience, zero BAC limits have been introduced across Australia for learner and probationary licence drivers. Impairment associated with the combination of low BAC levels and complex driving tasks is also reflected in the Australia wide adoption of zero BAC legislation for heavy and commercial passenger vehicles.

Alcohol impairment associated with illegal BAC levels (>0.05%) is widely documented; the effects of low, legal (<0.05%) BAC levels on driving and riding performance is now receiving more attention. Impairments in balance, reaction time, hazard and visual perception and attention, have all been associated with low (<0.05%) BAC levels (Palm et al., 2010; Lenné, Triggs and Redman, 1999; Deery & Love, 1996; Ouellet & Kasantikul, 2006). From their research into the effects of legal doses of alcohol on balance in experienced motorcyclists, Rudin-Brown and colleagues found that participants reported feeling intoxicated and having impaired balance following even low doses of alcohol at the 0.02% and 0.05% levels (Rudin-Brown, Clark, Allen, Mulvihill & Filtness, 2011). These low BAC related impairments are more apparent when associated with complex tasks and/or divided attention demands. Lenné et al., (1999) identified increases in driver reaction times associated with low (<0.05%) BAC levels which they attributed to an "*alcohol induced reduction in cognitive capacity*". Interestingly, these impairments were consistent across both novice and experienced driver participants.

2.1.2 Crash risk and BAC level

There is a growing amount of research highlighting the importance of acknowledging that alcohol related crash risk does not suddenly commence at the designated illegal 0.05% BAC level (Williams, McCartt and Ferguson, 2007; Compton, Blomberg, Moskowitz, Burns, Peck & Fiorentino, 2002). In their research into the relationship between serious injury crashes and BAC level, Philips and Brewer (2011) measured driving impairment using BAC increments of 0.01%. They identified a significant crash risk for drivers who were merely "*buzzed*" (any detectable BAC level) compared to sober drivers. *Buzzed* drivers were more likely to be: incorrectly restrained, speeding, and driving the striking vehicle, factors which increased their crash and injury severity risk.

A driver's increased alcohol related crash risk commences with the presence of any positive BAC and continues to increase into what is more commonly recognised as high risk levels (>0.10%). Williams et al., (2007) refer to the "*prevention paradox*", drawing attention to the elevated crash risks associated with lower (legal) BAC levels such as 0.04% and 0.05%. Citing data obtained in the Grand Rapids Study that found that 58% of the crash involved drivers were found to have a BAC of 0.8% or less. They propose that, due to the prevalence of drivers on the road with BACs in the 0.04 - 0.05% range, drink driving prevention strategies should also target these drivers who, in relation to exposure, may pose a greater actual crash risk than few drivers with a high level illegal BAC. Figure 1 identifies the relative risk of being involved in a casualty crash associated with increases in BAC levels.



Source: Office of Road Safety (2011a)

Figure 1: Casualty crash involvement risk estimates relative to BAC level

To provide a working example of the application of this relative risk curve concept on an average driving population, MUARC researchers (Cameron, Clark, Diamantopoulou & Watson, 2008) used a sample of BAC data obtained from 12,919 drivers randomly stopped at a booze bus RBT station in inner metropolitan Melbourne (see Table 1).

Table 1 Weighted casualty crash risk calculated from driver BAC levels

BAC result	No. of drivers	Relative risk	Weighted crash risk
0	12387	1	12387.00
0.01	119	1.1	130.90
0.02	124	1.2	148.80
0.03	113	1.4	158.20
0.04	56	1.6	89.60
0.05	26	1.8	46.80
0.06	36	2.5	90.00
0.07	18	3	54.00
0.08	11	3.2	35.20
0.09	7	5	35.00
0.1	2	5.5	11.00
0.11	13	6.5	84.50
0.12	1	7.1	7.10
0.13	3	10	30.00
0.16	1	12	12.00
0.27	2	40	80.00
Total	**12919**		**13400.10**

Source: Cameron, Clark, Diamantopoulou & Watson (2008)

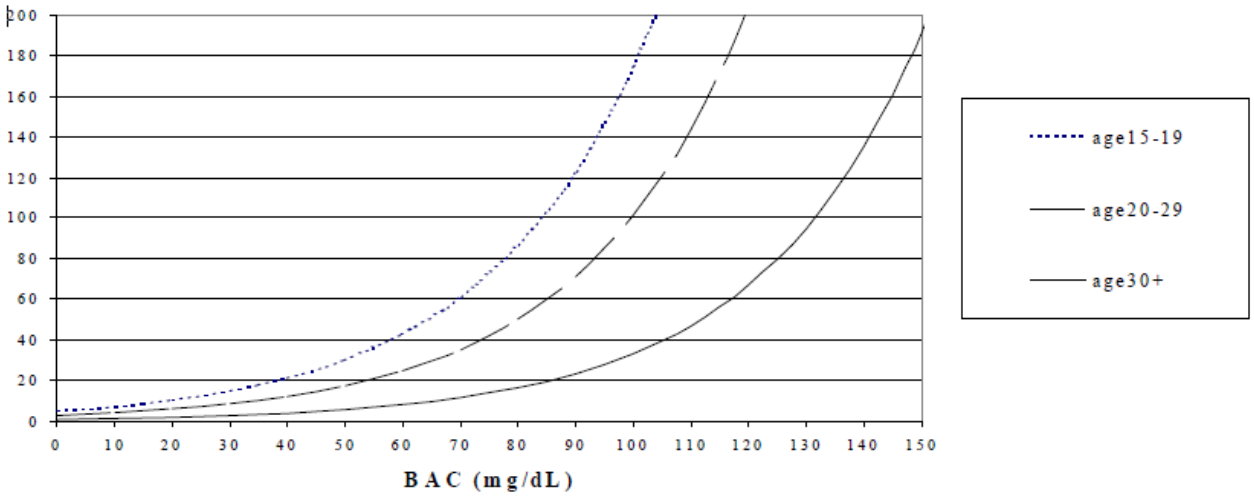
In terms of the relative risk of crash involvement, all drivers on the road face a risk of being involved in a crash. Assigning a relative crash risk of one to average drivers with a BAC of zero, then if all drivers in this sample had zero BACs the total risk of the sample would be 12,919. When the data are then weighted according to observed BAC, using the relative risks corresponding to these BAC levels, the *total aggregate risk* for the sample increases to 13,400.10, representing a 3.7% increase (100(13,400.1-12,919)/12,919). By having BAC profiles as shown in the table, drivers have increased the population crash risk by 3.7% compared to the scenario if all drivers had a zero BAC. Furthermore, the 438 drivers in the legal BAC range of 0.01-0.05% account for 28% of the overall population

crash risk increase (i.e., 1% of the total 3.7% increase). Exploring the increased casualty crash risk effects of drivers in the legal driving BAC range highlights the risks introduced by permitting individuals to drink and drive up to the legal 0.05% BAC level (Cameron et al., 2008). This example is calculated for casualty crash risk; fatality crash risk increases would be even greater.

2.1.3 Alcohol related crash risk by Age and Gender

Approximately 60% of the 21,855 Western Australian drivers who tested over the legal BAC limit in 2008/09 were under the age of thirty (ORS, 2011b).

The effects of alcohol on younger / novice drivers is well recognised and is reflected in the zero legal BAC limits for novice drivers adopted Australia wide. Younger drivers have a higher crash and injury risk compared with older, more experienced drivers with the same BAC level (ICAP, 2010); this increase in alcohol related crash risk is significant at all BAC levels (Palamara, Adams & Gavin, 2004). Figure 2 demonstrates the differences in relative risk associated with younger drivers (<29 yrs) compared to drivers thirty years and older.



Source: Frith & Strachan (2008)

Figure 2: Relative risk of driver fatality by age group

Research conducted by Keall, Frith and Patterson (2001) identified that, relative to older drivers (30+ yrs), young drivers with a low level BAC of 0.03% have five times the risk of being involved in a fatal crash. In WA, Young male drivers aged between 25-39 years are the highest risk group for both fatal and serious injury alcohol involved crashes, followed by 17-24 year old males (Johnson, 2010). Females aged 17-24 years also represent a high risk driver group.

Legislative changes lowering the legal BAC limit for learner and probationary drivers have been introduced Australia wide. In many Australian states, novice drivers cannot obtain their licence until they are approaching 18 years of age and are governed by a probationary licence zero BAC restriction for 3 years by which time they are a minimum of 21 years of age. The Western Australian drivers licensing age of 17 years is one of the youngest in Australia, with a probationary licence period of only 2 years. As a result, by the age of 19 years (an age within the bracket identified for its high alcohol related crash risk), many

WA young drivers are legally permitted to drink and drive to a 0.05% BAC level. This is also the common age of ETP patrons.

Variation in the effects of alcohol has been identified in relation to gender. Alcohol consumption guidelines to remain under the legal BAC have been modified in recognition of the difference in alcohol impairment between women and men. To remain under 0.05% BAC, men are advised that they can consume up to two standard drinks in the first hour and then one standard drink per hour thereafter, whereas women are advised to only consume up to one standard drink per hour (NHMRC, 2003).

2.1.4 Co-contributing factors

There is increasing recognition of co-morbidity issues relating to alcohol related crash risk, including interactions with other high crash risk factors such as fatigue, inexperience, and driver distraction (Palamara et al., 2004). Research conducted in the US into factors most commonly associated with alcohol-related crash involvement for teen drivers (16-19 years) found that alcohol involved crash risk was higher if driving was combined with having at least one passenger, and if it took place during the weekend night period (Bingham, Shope, Parwo & Raghunathan, 2009). The relationship between lower, legal (<0.04%) BACs and diving impairment across the entire driving population are mixed. Lower BAC impairment has been recognised for its relationship with an increased crash risk for younger, less experienced drivers / riders, especially when combined with other co-contributing risk factors such as fatigue and distraction. However, little is known about the interaction between these co-contributing factors and low BACs in other driving populations. In light of changing social drinking hours and behaviours, further research is required to explore these interactions on other driving populations such as women, shift workers, and the aged. This would provide more empirical insight into the crash risks associated with various population scenarios; for example a twenty-nine year old woman (who may have a lower alcohol tolerance) with a BAC of 0.04% who has been at an ETP until 1am and is fatigued from a long day and has not eaten for several hours.

Fatigue

Fatigue is a well recognised contributing factor in road trauma both in its own right and as a co-contributor with other factors such as inexperience, speed and drink driving. Keall and Frith (2005) identified a 40% increase in night-time injury crash risk for young drivers (under 30 yrs) after midnight compared to before midnight. However, due to challenges in identifying driver fatigue and empirically quantifying its effects, its relationship with crashes remains inconclusive. Current estimates suggest that fatigue is involved in 30% of fatal crashes in Western Australia (ORS, 2011c). The effects of fatigue have been likened to those of alcohol impairment. For example, sleep deprivation of between 17 to 19 hours has been put forth as being equivalent to a 0.05% BAC, while 20 to 25 hours deprivation is reported to be equivalent to a 0.10% BAC (Williams & Freyer, 2000). A night-time driving curfew (midnight to 5 a.m.) is legislated in WA for novice drivers during the first six months as probationary licence holders. Research shows that even low doses of alcohol result in increased driving impairment and crash risk when combined with fatigue (Vakulin, Baulk, Catcheside, Anderson, van den Heuvel, Banks & McEvoy, 2007; Iudice, Bananni, Gelli, Frittelli, Iudice, Ghicopulos & Murri, 2005; Barrett, Horne & Reyner, 2004). With the growing trend for extended alcohol trading hours, the combined effects of driving home after a late night at these venues with BAC levels in the higher range of the legal limit (e.g., 0.04%) is an area that warrants further research. For the younger high risk driver groups, it may be worthwhile extending the night-time curfew past six months.

Distraction

The effect of driver distraction, especially in relation to young inexperienced drivers, is well documented. Many Australian and international jurisdictions have introduced legislation in recognition of the increased crash risks resulting from driver distraction. Mobile phones and peer passengers are the most commonly recognised sources of driver distraction; however, there are many other sources of driver distraction such as GPS devices, audio systems, smoking, eating, and reaching for objects (Bayly, Young, & Regan, 2009). Some of the effects of driver distraction on driver performance are similar to those of alcohol impairment, such as reduced peripheral vision field (Langer, Holzner, Magnet & Martin, 2005), slower reaction times and lane position deviation (Young, Regan & Lee, 2009a). Therefore, the combination of alcohol and distraction exacerbates these effects, especially when engaging in complex or competing activities. Another effect of alcohol in relation to distraction is that it can increase the potential for a driver to become easily distracted or to focus on distractions for longer periods of time than otherwise (Young, Regan & Lee, 2009b). Further research is required to explore the interaction between alcohol and distraction on crash risk and to indentify the effects across various driving populations, such as those commonly targeted by ETP venues.

Passengers, especially young peer passengers, are another well recognised contributor to driver distraction (Chen, Baker, Braver & Li, 2000). In recognition of the relationship between peer passengers and increased crash risk, passenger restrictions have been introduced through graduated licensing systems across Australia. Distraction is not the only recognised effect of peer passengers; the presence of peer passengers has been found to encourage thrill seeking and other high risk driving behaviours (Keall, Frith & Patterson, 2004).

2.1.5 Other road users

Alcohol related road trauma is not confined to vehicle drivers and occupants; more than a third of all *pedestrian* fatalities involve a pedestrian BAC of 0.05% or greater (NRSC, 2011). The high fatality rates among alcohol impaired pedestrians are well documented (Oxley, Lenné, Corben & Potter, 2002; Rouse 2002). In WA, 44% of the metropolitan pedestrian fatalities that occurred during 2009 involved a pedestrian having a BAC of 0.08% or greater, and a further 28% had a BAC of 0.15% or greater. Fifty percent of pedestrians killed in non-metropolitan areas had a BAC of 0.15% or greater (ORS, 2011d). Alcohol impaired pedestrian crashes are not limited to individuals who are walking home; most social outings incorporate walking: from one drinking venue to another, from a venue to a vehicle to drive home, and from a venue to a designated public transport terminal. The necessity for many to walk home from venues with extended trading hours can be exacerbated due to early public transport closure times and a lack of available taxis at venue peak closing times. Pedestrian patrons with high BAC levels (due to a decision not to drive so they can consume greater quantities of alcohol) will be at greater risk of crash involvement.

Research conducted by Rouse (2002) provides a profile of pedestrian, alcohol related road trauma from data obtained between 1996 and 2000 in NSW. She identified that the pedestrian fatalities are an inner urban problem which occur in relatively low speed limit environments; up to the age of 70 years alcohol is a factor in 25% of all pedestrian fatalities; the majority of alcohol related pedestrian fatalities involving males. Ninety percent of pedestrian fatalities occur after dark, with 60% occurring on Thursday to Saturday nights. A BAC of 0.05% or greater was reported in 28% of pedestrian fatalities,

with 75% of these having a BAC of 0.15% or greater. More than half of all 17-49 year old pedestrian fatalities involved BACs of 0.05% or greater. Only 7% of fatalities occurred at a defined pedestrian crossing and, although 40% occurred on a road / carriageway, they were not engaging in crossing the road at the time of occurrence (Rouse, 2002).

Research conducted by Oxley, Lenné and Corben (2006) explored the effects of alcohol impairment on pedestrian road crossing behaviour using 41 participants aged between 25 and 35 years. Participants were divided into non-alcohol (zero BAC) and alcohol (BAC 0.05-0.10%, mean BAC 0.07%) cohorts. Five performance measures were used to explore the participants' pedestrian related responses to simulated pedestrian scenarios. The intoxicated participant group were found to partake in higher risk road crossing behaviour. They displayed deficits in relation to judging gaps in traffic necessary for safe crossing such as the approaching vehicle distance and speed this was especially so when faced with approaching vehicles travelling as slower speeds compared to high speeds. Even though they were aware of their impairment, the intoxicated participants displayed behaviours indicative of an increased degree of confidence.

2.1.6 Availability of BAC readings from crashes

In 2009, 63 (33%) of the 190 fatal road crashes in Western Australia involved drivers with a BAC of 0.05% or greater (ORS, 2011e). However, it is important to note that alcohol related crash rates are typically underestimated due to the omission of undertaking and/or reporting a BAC test from crash involved drivers / riders. For example, there were 22 '*unknown*' driver BAC levels in the 2009 fatalities sample. This underrepresentation is especially common when non-fatal hospital and lower severity crashes are considered. Table 2, sourced from a 2006 Road Safety Council of WA crash data report (Marchant et al., 2006), provides a good example of the degree of missing BAC data within each injury severity group, with 13% of fatal, 31% of hospitalisation and 86% of '*other*' crashes associated with '*unknown*' levels of driver/rider BAC.

Table 2 Driver/rider BAC by crash severity WA 2006

Highest Driver/Rider BAC in Crash (g/100mL)	Crash Severity									
	Fatal		Hospitalisation		Total Serious		Other		Total	
	n	Col %	n	Col %	n	Col %	n	Col %	n	Col %
Nil	96	52.7	1,192	56.4	**1,288**	**56.1**	3,959	10.6	**5,247**	**13.3**
> 0 to < 0.05	14	7.7	61	2.9	**75**	**3.3**	214	0.6	**289**	**0.7**
0.05 to < 0.08	4	2.2	32	1.5	**36**	**1.6**	169	0.5	**205**	**0.5**
0.08 to < 0.15	12	6.6	111	5.3	**123**	**5.4**	485	1.3	**608**	**1.5**
≥ 0.15	31	17.0	45	2.1	**76**	**3.3**	253	0.7	**329**	**0.8**
Subtotal ≥ 0.05	**47**	**25.8**	**188**	**8.9**	**235**	**10.2**	**907**	**2.4**	**1,142**	**2.9**
Unknown	25	13.7	673	31.8	**698**	**30.4**	32,189	86.4	**32,887**	**83.1**
Total Crashes[1]	**182**	**100.0**	**2,114**	**100.0**	**2,296**	**100.0**	**37,269**	**100.0**	**39,565**	**100.0**

1. Excludes crashes that did not involve a driver/rider (n=26).

Source: Marchant et al., 2006

The trend of not obtaining and/or reporting a BAC reading from crash involved drivers has long been a recognised challenge in obtaining accurate drink driving crash rate data. In the 1980s, 38% of the seriously injured driver BACs in Victoria were not reported, while the '*unknown*' BAC percentage was 78% for the 1999-2004 period and increased to 81% by 2005-2007 (Diamantopoulou & Clark, 2010). When attempting to explore whether the currently recognised High and Low Alcohol hours required updating to reflect changing

alcohol consumption patterns within Victoria, MUARC researchers found a substantial reduction in BAC reporting for all levels of crash injury severity. Documented BAC levels for drivers in fatal crashes had reduced from 90% in 2000-2004 to a surprising 3% in 2005-2008 (Diamantopoulou & Clark, 2010). While other data confounds are being explored in relation to this dramatic decline, the ongoing decline in the collection of BAC data is of concern. The importance of collecting and reporting BAC levels from all crash involved drivers warrants address. Not only does limited data mask the true degree of alcohol involvement in crashes on our roads, it hinders the ability to conduct robust evaluations of initiatives designed to target drink driving.

2.2 ALCOHOL SALES

"*Alcohol tax revenue in 1998-99 exceeded the total costs borne by governments for alcohol-related expenditures by $1.7 billion. Almost all this surplus accrued to the* **Commonwealth government."** (Collins & Lapsley, 2008, p.9)

2.2.1 Alcohol sales and crash rates

The relationship between social factors such as alcohol sales and road trauma has long been recognised within the road safety field (Cameron, Haworth, Oxley, Newstead & Le, 1993; Thoresen, Fry, Heiman & Cameron, 1992). In recognition of the strong positive relationship between alcohol sales and serious casualty crashes, Gantzer, Cameron, Newstead and Carr (1995) incorporated alcohol sales data as a key predictive factor into their countermeasures monitoring system. This monitoring system continues to be used today for examining the effects of road safety initiatives both in Victoria and interstate (D'Elia & Newstead, 2007; Newstead, Bobevski, Hosking, 2004). For example, in a MUARC study exploring the effectiveness of a Victorian multi-staged speed related strategy, increases in alcohol sales (deflated by the CPI) were found to be associated with a rise in *All Crashes* (fatal, injury and non-injury crashes) per kilometres travelled, and per population (D'Elia & Newstead, 2007).

For their research into the relationship between the availability of alcohol and alcohol related fatal single vehicle crashes, Gruenewald and Ponicki (1995) analysed alcohol sales data from beer, wine and spirits. They found that fatal crashes were more strongly related to beer sales than sales of wine or spirits which support previous research identifying that drink drivers often have a preference for drinking beer. Gruenewald and Ponicki also explored the proposition that restricting the availability of alcohol could lead to an increase in alcohol related crashes resulting from drink drivers travelling to a distant locality in order to purchase more alcohol. To the contrary, their research suggests that a reduction in alcohol related crashes would result from limiting the availability of alcohol sales venues. Again the effect of alcohol sales was most apparent in relation to beer sales during the hours of midnight to 4 a.m., with a 1.4% decrease in alcohol related crashes for every 1% decrease in beer sales (Gruenewald and Ponicki, 1995).

Breath alcohol level (BAL) can be used as a surrogate measure of crash risk. Research conducted by Chikritzhs and Stockwell (2006) explored the effects of ETP for alcohol introduced in 1993 on BALs and also on alcohol related crash rates in Perth. Pre and post ETP data were obtained from impaired drivers' crash reports, including the drivers' illegal BALs, from WA police reports obtained between July 1990 and June 1997. The data also included driver reported *last place of drinking* data, such as the name of the hotel, where relevant. Of the hotels identified as the last place of drinking, comparisons were made

between hotels that had adopted ETPs (1am closing) with hotels that adhered to the regular trading hours (midnight closing). Corresponding alcohol sales at the associated venues were grouped into high and low alcohol beverages. Findings identified an increase in alcohol impaired crashes associated with ETP venues. The research also found that increases in alcohol sales, especially high alcohol beverages, accounted for a significant proportion of the relationship identified between ETPs and impaired crash rates. However, average driver's BALs from these ETP venues were not found to be higher than those from drivers who came from non-ETP venues. The authors attributed this finding to the higher crash risks associated with younger drivers who patron the ETP venues compared to more experienced older impaired drivers from the non-ETP venues.

2.2.2 Profile of Extended Trading Practices (ETP) venues

From their research into ETP venues, Chikritzhs and Stockwell (2006) identified a common profile of the type of hotels that applies for and obtains extended trading hours. The profile identifies the majority of these venues as inner city hotels, with a younger age group clientele, that sell large amounts of what are recognized as '*high alcohol drinks'* (e.g., full strength beer, spirits) and are frequently reported as the last place of drinking by crash involved, alcohol impaired drivers (Chikritzhs & Stockwell, 2006). The authors suggest that these findings are predictable based on the rationale that licensed premises that choose to go through the application process to be granted ETPs would do so based on business profitability calculations. These calculations would be based on factors such as current patrons' drinking behaviour or the potential of attracting new patrons who are interested in extending their alcohol intake for longer periods of time. This rationale is supported by the observed increased alcohol sales occurring at these ETP venues.

The ETP venue profile outlined by Chikritzhs and Stockwell (2006) highlights the dual risk associated with these types of venues for the majority of patrons namely; that these ETP venues attract younger, male patrons, a group that is also already overrepresented in alcohol related crashes. Although the average BALs of crash involved drivers from ETP venues compared to non-ETP venues were similar, a greater frequency of crashes was reported for ETP venue patrons. The authors attribute these findings to previous research identifying that younger males show a preference for *high alcohol drinks*. Whilst over an entire night of drinking the consumption of *high alcohol drinks* by young male patrons does not appear to result in higher average BALs than for the older male patrons, when combined with driving inexperience these younger drivers pose a greater crash risk. Chikritzhs and Stockwell (2006) go further to suggest that the targeting of younger males by ETP venues combined with the pre-existing higher crash risks associated with these younger, novice drivers, creates a situation where this group of drivers is at greater crash risk from the onset. They propose that late night ETP venues target a group of drivers who to the contrary should be discouraged from attending these venues.

In Western Australia, the Road Safety Council and the Liquor Industry have developed the Skipper Program in attempts to discourage drink driving behaviour (see http://www.ors.wa.gov.au/Demographic-Pages/I-Am-A-Driver/Drink-Driving.aspx).
Licenced venues can register their participation in the program by contacting the Office of Road Safety. The aim of the program is to encourage peer groups to pre-plan alcohol involved outings by nominating a designated driver at the commencement of the evening. This designated driver can then present themself at any Skipper Program venue to receive an identification wrist tag entitling them to free soft drinks. Research was conducted to explore the effectiveness for the Skipper Program within the Western Regional city of

Geraldton (Boots & Midford, 1999). The program was found to result in more young drivers selecting a designated driver prior to commencing alcohol consumption, and the mass media campaign component of the program was found to have had the greatest influence on drivers compared to the licensed venue component. One negative outcome identified however, was a for "high risk takers" to consume large quantities of alcohol now that they were only passengers.

2.2.3 Availability of alcohol and consumption

Increased availability of alcohol has been shown to be associated with increased incidence of harmful alcohol consumption (Kavanagh, Kelly, Krnjacki, Thornton, Jolley, Subramanian, Turrell & Bentley, 2011; Livingston, Laslett & Dietze, 2008). In their Melbourne based research exploring the relationship between off-premise alcohol purchasing outlets and high risk alcohol consumption, Kavanagh and colleagues (2011) used multi-level logistical regression to analyse postal survey data obtained from 2334 participants aged between 18 and 79 years, with the available off-premise alcohol outlet density and proximity. They found that harmful alcohol consumption as defined by the NHMRC alcohol guidelines was associated with the number of alcohol outlets (density) within the local area. In conclusion, they recommend that efforts to address the prevalence of harmful levels of alcohol consumption should focus on restricting the number of outlets through which alcohol is available.

The importance of regulating the availability of alcohol, in attempts to address binge type drinking behavior amongst young males, is supported by research conducted by Livingston et al. (2008). Based on data obtained from the Victorian Youth Alcohol and Drug Surveys VYADS) found a significant association between what has been defined by the NHMRC as very high risk drinking behaviour and community level factors such as alcohol outlet density and remoteness. Access to recreational spending money was also identified as a key factor in the development of high risk drinking patterns; at the time of this research the risk became apparent for males with a recreational spending capacity of $80 or more a week (Livingston et al., 2008). Based on this finding, regarding the association between the amount of recreational spending money available to young working males and very high risk drinking behavior, Livingston et al. (2008) suggest that higher prices (e.g., taxes on alcohol) may reduce alcohol consumption among this group. Although many late night drinking venues already charge high prices for alcoholic beverages, applying limits to the amount of money taken into these venues or the availability of cash outlets within or in the near vicinity to these venues should be explored.

2.3 ALCOHOL ADVERTISING

Direct alcohol advertising is widespread through various media platforms such as newspapers, magazines, television, billboards, and on-line. However, more covert advertising can also be achieved through: product placement; sporting sponsorship; and the portrayal of popular media characters and social role models consuming alcohol (National Institute on Alcohol Abuse & Alcoholism, 2006).

Alcohol advertising can be seen to play two diverse roles in relation to drink driving. First, the flow on effects from alcohol advertising that endorses or, is often argued, creates a social culture that promotes alcohol consumption can make it difficult for vulnerable populations to separate their drinking and driving behaviours. Second, advertising has been used in road safety campaigns to highlight the risks associated with alcohol consumption and driving, in attempts to deter drink driving behaviour. Typically the alcohol industry

argues that overall alcohol consumption is not increased by alcohol advertising it merely affects an individual's choice of brand (Collins & Lapsley, 2008). To the contrary, public health advocates believe that alcohol advertising does result in increased alcohol consumption and the associated detrimental health and social issues that evolve from alcohol abuse (Collins & Lapsley, 2008).

2.3.1 Regulation of alcohol advertising

The influences of advertising on the development and/or perpetuation of social norms are well documented (King, Taylor and Carroll, 2005a; Saffer, 2002), and the alcohol advertising industry is far from an exception to this rule with alcohol advertising-to-sales ratios around 9% compared to general adverting-to-sales ratios of 3% (Saffer, 2002). Concerns about the influence of alcohol advertising on the general population, especially the adolescent and young adult population who are in the midst of forming their identities, have been raised by advocates from various public health domains. In attempts to address concerns surrounding alcohol advertising and adverse social outcomes, in Australia alcohol advertising content is currently regulated by the Alcohol Beverages Advertising Code (ABAC) and Complaints Management System, a self-governing body within the Advertising Standard's Board (DASSA, 2011). External complaints are reviewed by its Complaints Adjudication Panel; however, none of the 361 complaints presented to the Panel over the five-year period 1998-2002 were upheld (National Committee for the Review of Alcohol Advertising, 2003).

Research was undertaken through Curtain University (Donovan, Donovan, Howat & Weller, 2007) to explore the compliance of alcohol advertising with the ABAC. Self-regulation was not found to be effective in terms of ensuring compliance with the current ABAC. Therefore, the authors recommend that the government take a more active role in regulating compliance with the Code. This conclusion was based on the exploration of alcohol advertising in predominantly Australian produced magazines, appealing to 18-30 year old audiences. They found that, from the 93 editions (35 magazine titles) examined, approximately 66% contained at least one alcohol related advertisement ($n=142$, $\bar{x}=3$). Of a total of 142 advertisements contained within these editions, 52% were found to contravene the ABAC. The most common contraventions were in relation to Section B of the Code pertaining to advertising with a strong appeal to adolescents and also Section C pertaining to advertising alcohol in a manner suggesting that consumption will lead to positive social and/or sexual experiences (Donovan et al., 2007).

In Australia, advertising on commercial (free-to-air) television is governed by the Commercial Television Industry Code of Practice. According to the Code, direct alcohol advertising is permitted on television between the hours of 12 noon to 3 p.m., and 8:30 p.m. to 5 a.m., during weekdays and 8:30 p.m. to 5 a.m. on weekends and public holidays. However, these time restrictions do not apply if the direct alcohol advertising is accompanying a "live" sporting event (ACMA, 2010).

Research into television alcohol advertising was conducted for the Australian Department of Health and Ageing using Nielsen Media Research data (King, Taylor and Carroll, 2005b). Three fifths of the 34,830 metropolitan (Melbourne, Sydney, Perth, Brisbane & Adelaide) television station alcohol advertisements televised during 2004-05 were screened during the evening on weekdays, and the majority complied with the Code's times (8:30 p.m. – 5 a.m.). Of the advertisements screened on the weekends, 38% were broadcast during the day outside the recommended time frame; however, this was not

considered in breach of the Code because they were based on the "accompanying live sporting broadcasts" clause.

"*Youth are especially sensitive to discounts or point of sale promotions*" (Szalavitz, 2005). In response to the 2002 revision of the ABAC, the NSW Department of Health and Aging commissioned a survey of 1000 randomly selected Australians aged 18 years or older, to explore community attitudes to alcohol advertising (King et al., 2005a). There was a general consensus that alcohol advertising influenced drinking behaviour, with 69% of the sample agreeing that alcohol advertising "encouraged young people to drink", 54% reported that it encourages young people (<18 yrs) to drink *too much* and 45% believed it encourages the general population to drink *too much*. Many participants felt that alcohol advertising should face further restrictions (47%) or a complete ban (13%). Behind peer influences, alcohol advertising was rated as the second most influential factor on young peoples drinking behaviour.

It is important to interpret the lack of experimental evidence on the effects of advertising and alcohol consumption with some caution. In her research into the relationship between alcohol and advertising Szalavitz (2005) focuses on the common research methodologies used to evaluate the effects of advertising namely: experimental, survey, econometric, and media literacy. While she acknowledges that some research exploring the relationship between alcohol advertising exposure and attitudes to drinking have reported only small or short lasting effects, she explains that these studies have focussed on attitudes, not actual drinking behaviour. Szalavitz questions the validity of any experimental design in being able to accurately identify/measure the effects of lifelong exposure to alcohol advertising.

The National Drugs and Alcohol Strategy Report into the costs of alcohol abuse in Australia evolved following Collins' and Lapsley's participation as lead authors in the development of International Guidelines for the Estimation of the Avoidable Costs of Substance Abuse through the adoption of public policy (Collins & Lapsley, 2008) in Canada. This report, while based on expertise from their Canadian work, was modified by the authors to explore substance abuse within Australia. In it, attention is drawn to recent findings by Anderson and Baumberg (2006, cited in Collins & Lapsley, 2008) that alcohol consumption rates were 16% lower, and crash fatally rates 10% lower, in countries that had adopted partial alcohol advertising bans. A further reduction of 11% in alcohol consumption and 23% in fatal crash rates was predicted if this partial ban was amplified to a total ban on alcohol advertising (Anderson & Baumberg, 2006). Australian alcohol advertising would currently be classified within the category of *no alcohol advertising bans* (Collins & Lapsley, 2008). The estimated reduction in social costs associated with alcohol related road trauma resulting from the adoption of partial and full alcohol advertising bans were then calculated using Australian data. It was estimated that a move to *partial bans* from *no bans* would result in a $310 million decrease in road trauma costs, and a $960 million decrease if there was a move from *no bans* to *full bans.*

In attempts to reduce increases in alcohol consumption resulting from exposure to alcohol advertising, Saffer (2002) stresses that a sole focus on placing bans on television advertising will not suffice. He explains that bans on television advertising merely result in substitution to alternative forms of media. Therefore, to effectively address the influences of alcohol advertising, all forms of media need to be regulated.

Alcohol advertising on the internet was first included into the ABAC following its revision in 2004 (Carroll, Stewart, King, & Taylor, 2005). In their research exploring the effectiveness of including online alcohol advertising under the ABAC, Carroll et al. (2005)

identify that $1.4 million was spent on online alcohol advertising in Australia during 2002-03. Online advertising is a rapidly growing medium, with a 63% growth in overall online advertising occurring in Australia between 2002-03 and 2004-05, representing a total of $488 million spent on advertising in that year ('04-'05). A sample of their research recommendations listed below reflects the complexities associated with defining alcohol advertising and monitoring websites for their compliance with the alcohol advertising regulations.

- "*Further research is required to develop a set of agreed criteria of what constitutes an evident appeal to children and adolescents on Internet Web sites so that a full systematic review of alcohol beverage Web sites can be undertaken and consistency of content can be assessed with respect to the ABAC.*

- *Criteria for defining what constitutes an alcohol beverage Web site and for assessing what types of Internet sites are deemed acceptable for alcohol beverage sites to link to, or advertise on, also need to be developed. This is essential in order for alcohol beverage advertising on the Internet to be comprehensively assessed for consistency with the ABAC.*

- *Finally, a systematic means of capturing on-line advertising (e.g. banner advertisements on third party sites) needs to be developed to enable assessment of compliance of this type of Internet advertising with the ABAC.*" (Carroll et al., 2005, p: 1.)

2.3.2 Countermeasures to Alcohol Advertising - Public education

Robust evaluations into the effectiveness of public education advertising are difficult to conduct, because of the small scale and limited exposure of this form of advertising. Debate is rife regarding the appropriate methodologies to accurately gauge treatment effects (Collins & Lapsley, 2008; Saffer, 2002). Research into the effectiveness of the Transport Accident Commission's (TAC) road safety advertising highlights the importance of recognising the distinction between commercial advertising aimed at marketing a product and public education advertising aimed at influencing the audiences' attitudes and behaviours (Harrison and Senserrick, 2000). Commercial advertising aims to influence the consumer using strategies that focus on existing motivations and attitudes. On the other hand, successful public education campaigns traditionally have the more difficult challenge of having to modify or change the audience's attitudes and behaviour to ones that are often contradictory to, and less desirable than, their existing attitudes and motivations. This challenge is further confounded due to the often unconscious, automated nature of these behaviours. When designing public education advertising, it is important to identify whether the advertising will be targeted toward the consequences of behaviour, such as enacting crash scenes, or if it will be targeted toward the behaviour precursors, such as social norms and values (Harrison & Senserrick, 2000). In addition, commercial advertising outcomes are easier to evaluate using data on consumer recall and product sales. Whereas evaluations of public education advertising may offer comment on whether participants can recall road safety advertising and the intended messages, this is not a reliable indication of actual behaviour change.

A systematic review was conducted by Elder, Shults, Sleet, Nichols, Thompson and Rajab (2004) to explore the effectiveness of mass media campaigns on alcohol related crashes and drink driving rates. Their review into eight relevant public health programs identified a resulting median 13% decrease in alcohol related crashes. From an economic perspective

the results concluded that the costs of the programs were outweighed by the resulting social benefits.

Following MUARC's review into mass media road safety campaigns, Delaney, Lough, Whelan and Cameron (2004) recommend that best practice campaigns focus on using emotional persuasion compared to a rational, information based focus. They also stress the importance of sound theoretical foundations underpinning the campaign development. Finally, increased use of public relations and unpaid media coverage appears to be more effective than enforcement; however, the combination of public relation and enforcement strategies reported the largest effects.

MUARC's evaluation into the effectiveness of the TAC road safety television advertising campaigns identified a clear link between TAC alcohol enforcement advertising and a reduction in casualty crashes (Cameron, Haworth, Oxley, Newstead, & Tri Le, 1993). The estimated savings on related TAC injury compensation claims from road traffic crashes were 7.9 times the cost of the alcohol program advertising. Public education advertising was shown to be more effective when used in combination with community education programs; on its own it appears to have limited or short term effects especially on complex behaviours that are entrenched within social norms (Donovan & Carter, 2003).

"*Target Audience Rating Points (TARPs) provide scores representing the reach and frequency of alcohol advertising with a designated demographic group*." (King et al., 2005b, p:1). Research into the amount of advertising required for road safety and anti-smoking public education campaigns suggests between 200-250 TARPS/week for a minimum of eight weeks, followed up by a maintenance level of 80-100 TAPRS/week (Donovan & Carter, 2003). More entrenched beliefs, such as those that relate to reducing the speed limit by 10km/hr, were found to require additional periodic bursts of around 200-250 TAPPS to avoid a decline in effectiveness. The novelty of a message and exposure to the advertisement were found to be key factors in the effectiveness of public education advertising campaigns, which it is estimated result in behaviour change in an average of 9% of people within the target population (Donovan & Carter, 2003).

There are mixed reports surrounding the effectiveness of public education campaigns, especially in relation to more complex and socially reinforced behaviours such as alcohol consumption. The greatest effects of public education campaigns are apparent when they are paired with community level support such as increased police enforcement (Donovan & Carter, 2003). Public education advertising on its own, however, can be a useful tool in raising community awareness about new issues, unacceptable behaviours, and risks associated with particular behaviours. It can also play a role in raising the political profile of an issue.

The alcohol industry has the advantage of large budgets to invest in creating novel advertisements, which, contrary to ABAC regulations, portray alcohol consumption as part of a glamorous, sexy and socially exuberant lifestyle. A further advantage is that these alcohol product messages are often only required to reinforcing existing attitudes and motivations that have evolved from lifelong exposure to complementary advertising and social norms (Donovan & Carter, 2003). The amount of funding available for public education advertising is very small in comparison to the budgets available for alcohol sales advertising. Public education campaigns are usually aimed at modifying or changing well entrenched attitudes and behaviours, or taken further, face the task of undoing or undermining the pro-alcohol advertising (Donovan & Carter, 2003). Therefore, road safety advertising requires more resources, more sophisticated designing and more exposure to have any chance of attaining the same level of success as commercial alcohol advertising.

2.4 ENFORCEMENT

"*According to the 2001 NDS Household Survey, 12.8 per cent of Australians had driven a motor vehicle in the previous year while under the influence of alcohol*" (AIHW, 2002).

Police enforcement plays a key role in the detection of drink drivers and the prevention of alcohol related crashes through both general and specific deterrence strategies. Research shows that one's perception regarding the likelihood of being detected for drink driving is a key factor in the decision to refrain from driving when over the legal BAC limit (Clark & Bobevski, 2008). The level of resources devoted to drink driving enforcement, such as the number of hours committed to random breath testing, has been shown to have a direct effect (specific deterrence) on the number of drink drivers detected and also a general deterrence effect through exposure to this highly visible enforcement activity. The following section on enforcement has been included in this literature review in recognition of the key role that enforcement plays in deterring drink driving behaviour. A focus on enforcement strategies is vital to ensure its continued effectiveness in deterring and detecting drink driving during the current changes in social drinking patterns (such as ETP venues) and attitudes (online alcohol advertising) toward drinking behaviour.

2.4.1 Sanctions

In Australia, drink driving is viewed as a serious and high risk illegal driving behaviour and mandatory sanctions have been legislated to reflect the seriousness of the problem. In Western Australia, learner and probationary drivers, as well as drivers who have had a previous drink driving conviction within the last three years, are required to abstain from drinking alcohol when driving with BACs of 0.02% or greater resulting in penalties commencing at three months licence cancellation. Following licence cancellation, probationary drivers are required to re-sit both the theory and practical driving test to reobtain their licence. Full licence holders with a BAC of 0.05% or greater face fines of $100 to $2,500 depending on their evidentiary BAC level. A BAC of 0.08% or greater can result in licence disqualification ranging from three to six months for first offences. Second or subsequent drink driving convictions can range from a minimum of six months licence disqualification to permanent licence forfeiture for drivers with high BAC levels or those convicted for multiple offences (ORS, 2011d; WA Police, 2011).

Although over 19,000 drink drivers are detected in Western Australia each year (ORS, 2011a), the majority of drink drivers go undetected (Williams et al., 2007), with research indicating that one third of drivers convicted for drink driving will repeat offend (Featherstone et al., 2002 cited in NT Road Safety Taskforce, 2006). Repeat offenders, the majority of whom are males aged 25 years or younger, are 2.3 times more likely to be involved in a crash compared to the non-drink driving population (ORS, 2011d).

2.4.2 Intelligence based RBT enforcement

Although it is well recognised that a considerable proportion of drink drivers go undetected and that one's perception of being detected plays a key role in the decision to drink drive, research is rarely undertaken to evaluate RBT effectiveness with an aim to inform intelligence based RBT resource allocation and scheduling. An example of research based RBT recommendations can be found in research undertaken by Cameron and Strang (1982) aimed at evaluating the effectiveness of RBT in Melbourne. They recommended that urban RBT operations of 20 hours per $100km^2$ per week are necessary to achieve significant crash reductions. Research of this type detailing the appropriate enforcement

intensities necessary to achieve a significant result in crashes is well overdue for an update, especially in recognition of the changing social environment associated with extended alcohol trading hours.

The majority of drink driving enforcement and detection occurs through the deployment of booze buses. These highly visible buses allow for the random testing of high ratios of drivers in a safe environment for the police operators and motorists, with minimal disruption to traffic. Drivers detected with BACs over the legal limit can then undergo evidentiary testing onsite, avoiding the necessity to transport drivers back to the police station for evidentiary testing as is the case with car based testing. The other well recognised advantage of using booze buses for RBT is their high visibility and thus general deterrence effects on passing motorists (Delaney, Diamantopoulou, & Cameron, 2006). Typically, car based RBT is used for intercepts (targeted enforcement) rather than to set up a scheduled RBT site; however, research from New Zealand (Frith & Keall, 1997) has identified a shift by drink drivers from main roads to local residential streets in attempts to avoid detection. In inner city Melbourne, this shift of drink drivers to local streets where booze buses typically do not operate because of OH&S challenges has prompted a re-exploration of the importance of complementing the current booze bus RBT with vehicles able to operate RBT sites on smaller roads. A few specifically designed RBT minivans are now being used in inner city areas. These vehicles have the ability to conduct evidentiary testing on-site to overcome the evidentiary testing issue faced with car based testing sites.

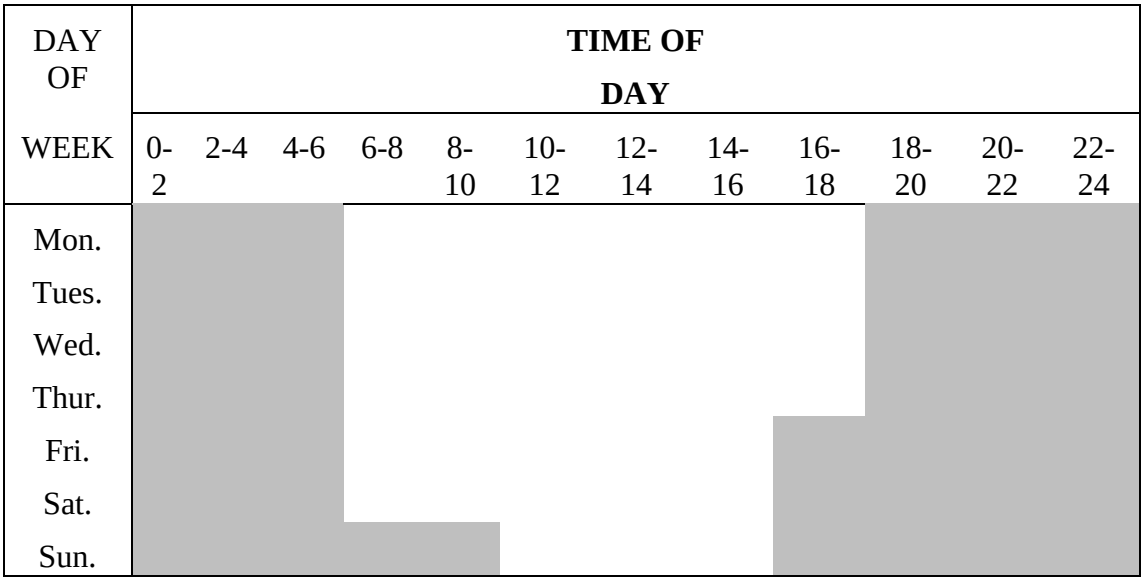
With the increased availability of alcohol purchasing outlets outside of normal trading hours, through both takeaway alcohol outlets and extended trading hours venues, it is important that maintaining the perception of a high chance of detection for drink driving is prioritised. In their research into the introduction of ETP, Chikritzhs and Stockwell (2006) outline that the increased crash rates associated with higher alcohol sales were moderated by the placement of booze buses on freeway travel routes surrounding venues granted ETP licences. They propose that the deterrent effect of these highly visible drink driving enforcement practices should be explored as a crash prevention strategy in relation to late night drinking venue localities.

Geographical data suggests that the density of licensed entertainment venues is associated with drink driving. Victoria Police RBT data from 2008 was analysed to identify the top twenty locations across Victoria with the highest rates of drink driving detection. Five of the top twenty sites identified from the entire state were from one inner city police region, the same region that houses the highest concentration of licensed entertainment venues in the state (Clark, Diamantopoulou & Cameron, 2010). It is important to note, though, that a bias may exist in identifying the highest drink driving detection rates as it may also reflect the level of RBT scheduled in these locations.

In inner city Melbourne, Victoria Police have devised co-ordinated RBT operations setting up corrals around inner city extended trading hours precincts. These corrals involve the strategic placement of six or seven booze buses and around five satellite back up cars to ensure that drivers will pass at least one RBT site in order to access freeway and other main road corridors to the outer suburbs. These large operations are resulting in approximately 1:70 drink driving detections compared to the regular booze bus average of 1:200 (Clark et. al., 2010). In one such corral operation conducted in inner city Melbourne on a Friday evening in June 2008, 44 drivers were detected with BACs in excess of the legal limit resulting in a 1:81 detection rate. Of these 44 drivers 59% lived locally, and the remainder were from outer suburbs. Calculations of the distances these drivers intended to

travel (based on their home address) if they hadn't been detected showed that, collectively, they would have driven over 500 kms that evening while being over the legal BAC limit. The identification of this level of exposure to drink drivers for other drivers on the road highlights the importance of obtaining data relating to the locality of the venues that these drivers depart from, the suburbs from which they are travelling to and from to attend these venues, and the mode of transport used. It also supports the placement of RBT sites as close to these venues as feasible to reduce the exposure to drink drivers for other road users (Clark et al., 2010).

The identification of "*High Alcohol Hours*" (HAH) evolved through attempts to develop surrogate measures of alcohol involvement in crashes due to the limited amount of actual BAC data obtained from these crashes. The initial high alcohol hours times were developed by South (cited in Hague and Cameron, 1987) and were based on Victorian crash data from 1976-1982. Alcohol Hours were defined as those time periods where the proportion of known driver BAC levels over 0.05% were greater than 15%. The respective hours of the week were the identified as "*alcohol times*" and "*non-alcohol times*". High Alcohol Hours (HAH) depict the times of the day and week where the greatest proportion of alcohol involved crashes occur. A review of HAH was undertaken by Harrison (1990) using crash data from 1988-1989, with two further updates undertaken by Gantzer, Cameron, Newstead and Carr (1995) using 1990-1994 crash data, and Shtifelman, Cameron and Diamantopoulou (1998) using 1990-1997 crash data. Figure 3 below shows the most recent HAH data available for metropolitan Melbourne.



Source: Shtifelman, Cameron and Diamantopoulou (1998)

Figure 3: High Alcohol Hours of the Week (shaded) for Melbourne, 1990-1997

HAH have been used extensively in research into alcohol involvement in crashes such as that by Gantzer et al. (1995) that found that fatal and serious injury crashes in rural Victoria, involving drivers with a BAC over the legal limit, were seven times greater during HAH compared to Low Alcohol Hours (LAH). HAH are also used by police for RBT scheduling, with the majority of booze bus sites operating within HAH. In the road safety field, HAH typically refer to the high social / entertainment hours on weekends from around 4 p.m. on Friday to 10 a.m. Sunday. As highlighted earlier (see section 2.3.1), this

is also a time frame in which there is an increase in alcohol advertising paired with live sporting event broadcasts.

During 2008, MUARC was commissioned by its road safety sponsors to explore the feasibility of updating the HAHs in Victoria. This request arose in recognition of the changing employment hours such as increases in shift work and the resulting changes in social/entertainment hours. With these changes in entertainment venue demands and the resulting expansion of late night venues, inner city Melbourne is close to being a 24 hour entertainment venue. The Victoria Police, especially those stationed in the inner city region, were keen to have the HAH reviewed to explore their accuracy and/or relevance to current trends. Many booze bus operations currently conclude at around 1-2 a.m., just prior to a common venue closing time when patrons are making their way home or to other venues with later licensing hours. As mentioned earlier (see section 2.1.6), the decline in availability of BAC data within crash data made it impossible to re-define HAH using crash data; however, another surrogate data matching method using Victoria Police RBT data has been proposed (Diamantopoulou, Clark & Cameron, 2010). The applicability of this surrogate data matching method to WA RBT and crash data requires further investigation.

With the expansion of extended trading hours, it is important that research is undertaken in Western Australia to explore the effects of these alcohol sales hours on HAH and LAH, within both the metropolitan and rural areas. This information is invaluable in ensuring that RBT resources are targeted to maximise cost benefits. Intelligence based RBT scheduling should be a priority and focus on both the highly visible booze bus operations to maximize the general deterrence benefits but also on car based operations to address any growing perceptions that RBT sites are predictable and can be avoided using residential and local streets.

3 SUMMARY OF KEY FINDINGS

3.1 ALCOHOL AND CRASH RISK

- Alcohol is involved in approximately 1/3 of all fatal road crashes
- Crash involved driver BACs remain underreported (unknown) and, as recently identified in Victoria, this underreporting may be on the increase
- Alcohol related crash risk does not commence at the illegal BAC level of 0.05g/100ml, it commences with a positive BAC and increases in relation to BAC increases
- In relation to exposure, the number of drivers with legal 0.04 -0.05 BACs may pose more of a risk than one driver with a high illegal BAC level
- Young drivers (≤ 30 yrs) are overrepresented among drivers detected with illegal BACs (60% in 2008-09)
- Young males aged 25-39, followed by males aged 17-24 years, are the highest alcohol crash risk groups (fatal & serious injury); females 17-24 are also a high risk group
- WA drivers are the youngest drivers in Australia to come off probationary zero BAC restrictions, coinciding with the highest alcohol related crash risk age group
- Research is needed to explore the co-morbidity of alcohol related crash risk and factors such as fatigue, distraction
- Alcohol related road trauma is not limited to vehicle occupants, with 40% of pedestrian fatalities involving pedestrian BACs of over 0.05%
- Social outings frequently involve walking long distances to get home or short distances to access taxi or public transport terminals; alcohol intoxication places these pedestrians at greater risk of crash involvement.
- Pedestrian fatalities are typically an inner urban problem; intoxication reduces the pedestrian's ability to safely judge gaps in traffic, especially of vehicles travelling at lower speeds

3.2 ALCOHOL SALES

- The relationship between alcohol sales and crash risk is well recognised.
- In recognition of its strong relationship with casualty crashes, alcohol sales are used as a predictive factor in crash modelling
- Alcohol sales are associated with a rise in fatal, injury and non-injury crashes
- Alcohol-related single vehicle crashes were found to be more closely related to beer sales than to sales of wine or spirits

- The effects of late night restrictions limiting the availability of alcohol were most notable in relation to beer sales, with reductions in alcohol related crashes corresponding to the reduction in beer sales.

- Increases in alcohol related crashes were associated with increases in alcohol sales (especially high alcohol content beverages) for Extended Trading Practices (ETP) venues in Perth

- An Extended Trading Practices venues profile was identified as: inner city hotels, with a younger age group of patrons, who sell larger amounts of what are recognized as high alcohol drinks (e.g., full strength beer, spirits.), and are frequently reported as the last place of drinking by crash involved, alcohol impaired drivers

- Extended Trading Practices venues target the very drivers who, due to the associated increased crash risk factors, should not attend these types of venues

- The Skipper Program sponsored by the Liquor Industry aims to reduce drink driving by encouraging groups to identify a designated driver prior to going out. The designated driver receives free non-alcoholic beverages at affiliated venues

- Increased availability of alcohol has been shown to be associated with increased incidence of harmful alcohol consumption

- Access to recreational spending money was also identified as a key factor in the development of high risk drinking patterns

3.3 ALCOHOL ADVERTISING

- Alcohol advertising can be used in two ways: to increase alcohol sales, and as a public education medium to raise community awareness of the risks associated with alcohol abuse or road safety issues such as drink driving

- Alcohol companies argue that advertising influences brand choice and does not increase consumption, public health advocates disagree claiming it does lead to increases in alcohol consumption. Methodological challenges surrounding accurate ways to measure the effects of alcohol advertising hinder the ability to resolve this debate.

- Alcohol advertising-to-sales ratios are around 9% compared to general advertising-to-sales ratios of 3%

- covert alcohol advertising such as product placement, sports sponsorship, and depiction of role models consuming alcohol is widespread and does not come under the governance of regulatory codes; its long terms effects are difficult to evaluate

- In Australia, the content of alcohol advertising is regulated by the Alcohol Beverages Advertising Code (ABAC)

- Criticisms have been raised questioning the effectiveness of the ABAC on alcohol advertising as it is a self-regulated system; complaints to the ABAC about advertising breaches rarely result in penalties for the respective companies

- The most common breach of the ABAC was found to be in relation to alcohol advertising attempting to appeal to adolescents, secondly in relation to advertising suggesting that alcohol consumption leads to more positive social or sexual experiences

- Television based alcohol advertising has time scheduling regulations to reduce children's exposure; however, advertising is readily permitted outside these regulated hours if paired with a live sporting event

- Research found that, on weekends, 38% of the alcohol advertising (Australian capital city TV channels) was screened outside the regulated hours through the use of the "accompanying live sporting broadcasts" clause.

- Research into attitudes to alcohol advertising identified that alcohol advertising was rated as the second greatest influence (behind peer pressure) on young people's alcohol consumption behaviour; 60% of participants thought that alcohol advertising should face further restrictions or bans

- Australia is currently viewed as having no alcohol advertising bans. A move to partial bans is predicted to result in a 16% reduction in alcohol consumption and a 10% reduction in crash fatality rates; greater reductions would result from the introduction of full alcohol advertising bans

- A $310 million decrease in road trauma costs have been estimated from a shift from no bans to partial bans, and a $960 million decrease from no bans to full bans.

- Proposed alcohol advertising bans need to target all advertising media to avoid substitution to other media

- Online alcohol advertising is rapidly increasing and, while it has been included in the ABAC, breaches are extremely difficult to detect and monitor

- Typically the small amount of funding and data available from public education campaigns make them difficult to evaluate.

- It is important to recognise the distinction between commercial advertising aimed at marketing a product, and public education advertising aimed at influencing the audiences' attitudes and behaviours

- Commercial advertising outcomes are easier to evaluate such as data on consumer recall and product sales. Public education advertising cannot be measured by recall of road safety advertising as this is not a reliable indication of actual behaviour change

- A review of eight mass media public education campaigns found a 13% (median) reduction in alcohol related crashes

- The estimated savings on related Transport Accident Commission (TAC) injury compensation claims from road traffic crashes were 7.9 times the cost of the alcohol program advertising

- Public education advertising has been shown to be more effective when used in combination with community education programs

- The novelty of the campaign messages and exposure to the advertisement have been found to be key factors in the effectiveness of public education advertising campaigns

- Complex and socially reinforced behaviours are more difficult to change using public education campaigns alone

- Media campaigns using emotionally persuasive messages with a sound theoretical basis have been identified as best practice

- Road safety advertising requires more resources, more sophisticated designing and more exposure, to have any chance of attaining the same level of success as commercial alcohol advertising

3.4 ENFORCEMENT

- A high perception of detection is a key determinant in the decision to refrain from drink driving; it is important that enforcement strategies focus on maintaining a high perception of detection within the road user community.

- Drink driving enforcement evaluations are necessary to ensure that current enforcement practices address the changes in social drinking patterns (such as ETP venues) and attitudes (online alcohol advertising) toward drinking behaviour

- The majority of drink drivers go undetected; in 2001 approximately 12.8% of Australians had driven a vehicle under the influence of alcohol

- Approximately one third of drivers detected for drink driving will re-offend

- Research conduced in 1982 recommended that, to achieve significant crash reductions RBT operation of 20 hours per 100km^2 per week (urban areas) were necessary. Current and ongoing recommendations of this type are needed to ensure maximum RBT resource allocation

- The majority of drink driving enforcement and detection occurs through the deployment of 'booze buses'

- Typically, car based RBT is used for intercepts (targeted enforcement) rather than scheduled RBT sites

- The predictability of booze bus locations on major roads has resulted in drink drivers using smaller local streets to avoid detection

- Increased crash rates resulting from ETP venues have been modified by locating highly visible booze bus RBT sites near these venues

- In Victoria high drink driving detection locations reflect the locations of inner city ETP venues

- Setting up RBT corrals (all drivers are required to pass to get home) around inner city ETP venues has resulted in higher RBT detection rates within Melbourne.

- *High Alcohol Hours* have been defined as those time periods where the proportion of known driver BAC levels over 0.05% are greater than 15%, and depict the times of the day and week where the greatest proportion of alcohol involved crashes occur

- RBT is often scheduled around high alcohol hours; however, these hours are overdue for re-evaluation and may require updating to reflect the growing trend of ETP and shift work

- Booze bus sites often close at 1 – 2 a.m. and are therefore not operating when patrons leave ETP venues at the common 2 a.m. closing time.

- Intelligence based RBT scheduling should be a priority

- highly visible booze bus operations should be utilized to maximize general deterrence effects

- car based operations should be increased to address the use of residential and local streets by drink drivers aiming to avoid detection

4 RECOMMENDATIONS

The following recommendations have evolved from the above literature review exploring the links between BAC limits, alcohol sales and advertising on road trauma.

4.1 RECOMMENDATIONS FOR FURTHER RESEARCH

Further research and ongoing monitoring of evolving research into the effects of low level BACs on driving skills / performance across the entire road user population and within specific demographic groups needs to be pursued

Further research and ongoing monitoring of evolving research should also be undertaken into the relationship between alcohol-related crash risks and co-contributing factors such as fatigue and distraction across the entire road user population and within specific demographic groups.

Further research and ongoing monitoring of evolving research on alcohol-related crash risks for pedestrians should be pursued. This could include monitoring of pedestrian alcohol involved crashes to detect any shifts that may occur from successful drink driving deterrence strategies. The lack of BAC readings obtained from pedestrians is recognised, and this may also warrant further exploration.

Exploration into the RBT and crash data currently collected by the WA Police and other relevant agencies, including exploration of specific variables, is warranted to ensure its applicability for conducting robust evaluative research.

In recognition of the fatal and serious injury crash risks associated with alcohol and the challenges in identifying alcohol impairment across various driving populations and combined with other co-contributing factors, the feasibility of introducing zero BAC legislation across the entire driving / riding population should be further investigated.

4.2 RECOMMENDATIONS REGARDING DATA COLLECTION, LINKING AND ANALYSIS

Exploration of the current level of BAC testing of crash involved drivers and pedestrians within Western Australia is needed. This exploration could target potential biases in unknown BAC testing such as age, gender, and time of week. Two specific areas should be examined:

- Investigation of police protocols for BAC testing when attending and reporting crashes; and

- Implementation of improved hospital BAC testing protocol and practices is a priority. This should include (but not be limited to): identifying reasons for large proportions of “unknown” crash involved driver BACs, potential staff biases in their choice of who to test, exploring whether the underreporting is due to the lack of testing or to official recording protocols among hospitals and police.

Exploration of the feasibility of introducing mandatory BAC testing of all crash involved drivers / riders, including those who attend local medical centres with minor injuries, should be conducted.

Detailed recording of alcohol consumption, including last place of alcohol consumption, in police RBT data is recommended, as is ensuring that RBT data is actively analysed to identify high risk alcohol serving venues and locations.

Data linkage opportunities should be examined to explore the feasibility of linking RBT, BAC, alcohol sales and alcohol advertising data on an ongoing basis to enable more in-depth analysis to identify the causal relationship among these factors.

Further research and ongoing monitoring of ETP venue patrons (e.g., demographics, alcohol preference, alcohol consumption level) is warranted. Access to this data will provide valuable information to inform future licensing practices, as well as drinking patterns to inform drink driving prevention strategies.

4.3 RECOMMENDATIONS REGARDING ALCOHOL ADVERTISING

In recognition of the associations between alcohol advertising and increases in alcohol consumption and alcohol related crashes (especially for drivers under the age of 30 years), the effectiveness of self-regulated industry compliance to the respective Codes warrants further investigation. This should include exploring the effectiveness of current methods for detecting and sanctioning breaches.

The use of the ABAC sporting event sponsorship clause to advertise alcohol during daytime hours associated with peak child viewing times requires immediate attention. This common practice appears to be supportive of promoting a philosophy that sport and alcohol take precedence over the healthy development of children.

In recognition of the associations between alcohol advertising and increases in alcohol consumption and alcohol related crashes (especially for drivers under the age of 30 years), the growing use of online advertising warrants further investigation. Part of this research focus should be on appropriate and effective regulations and Codes of Practice as suggested below by Carroll et al. (2005).

- "*Further research is required to develop a set of agreed criteria of what constitutes an evident appeal to children and adolescents on Internet Web sites so that a full systematic review of alcohol beverage Web sites can be undertaken and consistency of content can be assessed with respect to the ABAC.*

- *Criteria for defining what constitutes an alcohol beverage Web site and for assessing what types of Internet sites are deemed acceptable for alcohol beverage sites to link to, or advertise on, also need to be developed. This is essential in order for alcohol beverage advertising on the Internet to be comprehensively assessed for consistency with the ABAC.*

- *Finally, a systematic means of capturing on-line advertising (e.g. banner advertisements on third party sites) needs to be developed to enable assessment of compliance of this type of Internet advertising with the ABAC.*" (Carroll et al., 2005, p 1.)

Further exploration is needed into the cost effectiveness (in relation to alcohol related trauma costs and alcohol advertising revenue) of legislating partial and/or full alcohol advertising bans.

In recognition of the findings that complex and socially reinforced behaviours are more difficult to change using public education campaigns alone, further research and ongoing monitoring of evolving research into the effectiveness of public education campaigns in addressing drink driving are warranted.

Further research is needed to explore the ability of public health campaigns to counter the effects of alcohol advertising, with a focus on the adoption of these campaign messages by various road user groups.

4.4 RECOMMENDATIONS REGARDING ENFORCEMENT

Strategic placement and advertisement of RBT sites surrounding late night ETP venues (e.g., the Victoria Police corral model) is recommended to develop and reinforce the association between ETP venues and RBT sites.

In light of the growing research in this area, the increased use of car based RBT sites to deter drink drivers from using smaller local streets is recommended.

Further research is required to explore the relevance of the currently available high alcohol hours, in view of changes in social drinking hours and patterns. This information is valuable for RBT scheduling and it may result in extended hours for RBT around ETP venues.

Further research is necessary to explore the RBT enforcement resource allocation for the Western Australia Police. This should include deployment hours, resource allocation, scheduling, and site location

The promotion of RBT is important to ensure that a high perception of detection is maintained within the road user community.

4.5 OTHER RECOMMENDATIONS

The provision and adequate supply of alternative transport methods such as night-rider buses, taxis, and increased late night operating hours for public transport to correspond with ETP venue closing times, needs to be addressed

5 CONCLUSION

The general relationship between alcohol consumption, driving / riding impairment, and crash risk is well recognised. Although the debate regarding the degree of impairment corresponding with specific BAC levels and particularly for low BACs is ongoing, this should be viewed as fine tuning rather than questioning the fundamental relationship. Within the road safety field, pharmacological developments leading to improved accuracy in BAC testing have provided the opportunity to further explore the appropriateness of current legal driving BAC limits. Research using both simulated and naturalistic methodologies to explore alcohol impairment across various driving / riding populations, as well as the effects of co-contributing factors such as age, gender, fatigue and distraction, continues to provide empirical evidence to guide policies and legislation surrounding alcohol consumption and road users.

There is a growing trend across Australia to increase alcohol purchasing hours through an increase in the numbers of takeaway outlets and extended trading hours venues. The effects of extended alcohol trading hours on drink driving and alcohol related crashes require ongoing monitoring and empirical evaluation. Alcohol sales are further promoted through extensive, high budget advertising. The amount of advertising and the degree of exposure necessary to result in an increase of alcohol consumption is difficult to calculate empirically. However, research claiming that alcohol advertising results in increased alcohol consumption, especially amongst high risk groups such as young males, does exist. Australian alcohol advertising is currently governed by the ABAC and the Commercial Television Industry Code of Practice; however, it appears that breaches of these regulations seldom result in sanctions, and that methods to circumvent them, such as using sporting sponsorship, are common practice. The effectiveness of alcohol advertising bans and public education campaigns as countermeasures warrants further investigation.

While the majority of drivers comply with drink driving legislation, drink driving continues to represent a significant road safety problem. Drink driving enforcement initiatives need to be intelligence based. Random breath testing (RBT) data should be explored for its relevance and comprehensiveness in facilitating ongoing monitoring and evaluation of drink driving patterns and trends.

Alcohol related crash risk is a significant and ongoing road safety issue with the associated costs, direct and indirect, financial and emotional being considerable. With the successful adoption of zero BAC limits for learner and probationary licence holders across Australia, there is now a generation of young drivers who have widely accepted and adapted to the necessity of separating their driving behaviour from their alcohol consumption behaviour. Perhaps now is an opportune time to consider whether a long term solution to the drink driving and alcohol related crash risk problem would be to extend the zero BAC legislation for these drivers until they reach the lower alcohol related crash risk age group (30 – 40 yrs), or perhaps even indefinitely across the entirety of active driving years.

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