ROAD SAFETY IMPACT OF ESTABLISHING BLOOD ALCOHOL CONCENTRATION LEVELS AT 0.05

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1. A BRIEF STATEMENT OF THE ISSUE

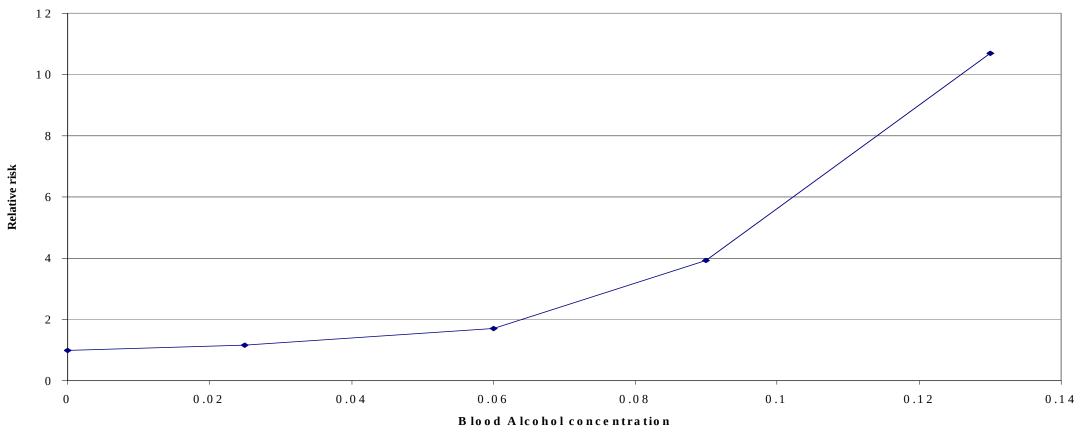
It has long been recognised that excessive alcohol consumption affects a person's ability to drive a vehicle. Accordingly, many countries have legislated to restrict the permissible blood alcohol concentration (BAC) for driving to 0.05 (50 mg of alcohol per 100 millilitres of blood). However other jurisdictions and/or some segments of the public argue that a BAC limit of 0.05 is too restrictive and has minimal road safety benefits.

The purpose of this paper is to quantify and explain the crash risks associated with different BAC levels and to identify the range of road safety benefits when the maximum permissible BAC level is set at 0.05.

2. AN ASSESSMENT OF THE ROAD SAFETY PROBLEM

The association between drink driving and crash risk was first formally quantified in the 'Grand Rapids' study. This study, carried out in 1962-63, compared the BACs of the drivers in a random sample of all reported crashes in Grand Rapids, Michigan, with a control group of drivers selected at the same locations and times as the random sample of crashes. It found that the crash risk rose with increasing BAC, so that for example, drivers with a BAC of 0.05 mg had around 1.5 times the crash risk of drivers with a zero BAC. The risk curve became steeper as higher alcohol levels were reached (see Figure 1) (Borkenstein, Crowther, Shumate, Ziel, & Zylman, 1964).

Figure 1: Drivers' blood alcohol concentrations and the relative risk of police-reported crash involvement.

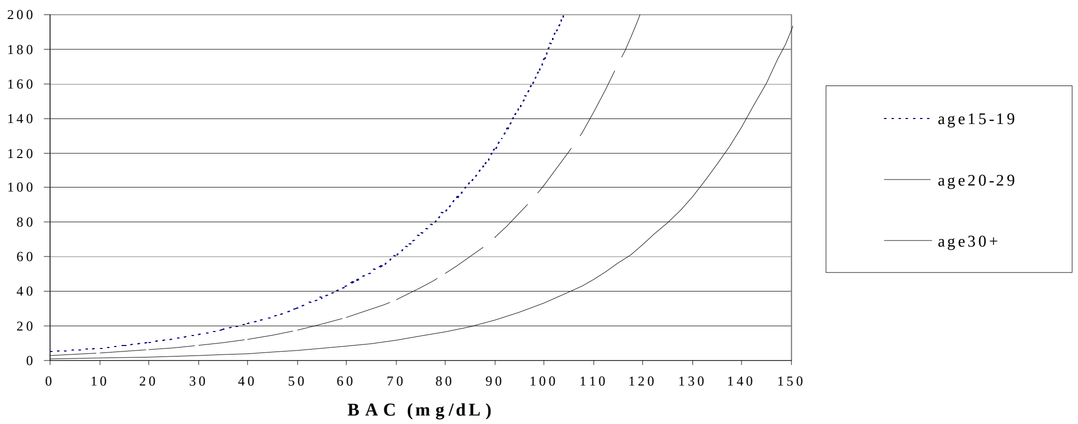


Since Allsop (1966) confirmed the basic shape of the curve, the data have been further analysed (for example Hurst, Harte, & Frith, 1994). In 2000, a similar study undertaken in Long Beach, California and Fort Lauderdale, Florida, showed that the resulting curve was steeper than that from the Grand Rapids study but the risk estimates were broadly similar at lower alcohol levels (Compton, et al., 2002).

As the severity of the crashes increase, the association between BAC and crash risk becomes more marked. For example, a British study found that drivers with a BAC of 0.04 had 3.7 times the risk of being killed in a crash relative to drivers with a BAC of zero (Maycock, 1997). For drivers with a BAC of 0.08 this figure rose to 12.4 times the risk, and for drivers with a BAC of 0.16, the risk was 154 times.

The association between alcohol levels and crash risk is also related to the age of the driver. Keall, Frith and Patterson (2001) estimated that teenage drivers with a BAC of 0.03 had five times the risk of being fatally injured in a crash relative to drivers aged 30 years and over at the same BAC level. The risk levels were significantly higher at all BAC levels for drivers aged under 20 and aged 20-29, relative to drivers aged 30 and over (see Figure 2). This increased risk for the drivers themselves, as well as their passengers and other road users, has been used to justify the lower BAC limits imposed on young drivers in many jurisdictions.

Figure 2: Relative risk of driver fatal injury by age group



The effects of alcohol on crash risk are further increased when alcohol is consumed in combination with other drugs (for more information, refer to the associated Handbook paper describing the role of cannabis in road crashes).

Despite the evidence linking drink driving to increased crash risk, some argue that the legal limit for drink driving should be set higher than a BAC of 0.05. There are two main points of argument for this stance:

- it is difficult for many to accept that a BAC of about 0.05 increases crash risk, especially when a person may appear fully sober and in control of all faculties;
- most of the driver fatalities arising from drink driving involve a BAC of 0.15 or above. Over the past five years in New Zealand for example, 62% of all driver deaths associated with drink driving involved BACs exceeding 0.15, whereas BACs of 0.05-0.08 accounted for 7% of these deaths.

3. CURRENT PRACTICES IN AUSTRALASIAN JURISDICTIONS

All Australian jurisdictions now have a general blood alcohol limit of 0.05, with most having lower limits for younger, learner or commercial vehicle drivers. New Zealand has a legal limit of 0.08, with a lower limit of 0.03 for teenage drivers.

4. A REVIEW OF THE RESEARCH

4.1 Behavioural effects of alcohol

Techniques for testing and measuring alcohol-related degradations of behaviour have improved markedly in recent years. Since the Grand Rapids study, research based on these techniques has consistently shown that performance on a variety of cognitive and psychomotor tasks is measurably impaired at even modest BAC levels, overt appearances notwithstanding. However laboratory studies cannot determine exactly the extent to which a decrement in a given behavioural task will cause a decrement in driving performance or an increase in crash risk.

Tests of actual driving performance, conducted either in on-road settings or in driving simulators, promise more realistic estimates of the effects of alcohol. As noted by Lenné, Triggs and Redman (1999), impairments are typically measured by increased lateral deviation, but other measures are also sometimes used. The limitations of such tests are well known but have been reduced in recent years by technological advances that have made simulators and measurement techniques more sophisticated and more sensitive to alcohol effects.

Considering the most recent studies, (for a summary of earlier studies see particularly NHTSA, 2001), Ogden and Moskowitz (2004) demonstrated that many studies have shown consistent performance impairment across a range of skills related to driving including: vigilance, from BAC levels as low as 0.005; divided attention task, from BAC levels of 0.015; and vision, from BAC levels of 0.04. They also reported on studies assessing impairment of actual driving skills through the use of simulators and closed driving courses. From BAC levels of 0.03 steering errors are noticed, and collision frequencies rise. Below a 0.05 BAC, participants ignore rules and instructions, and at low to moderate alcohol doses they are more sluggish to correct errors in positioning and their steering control responses deteriorate. In relation to studies assessing impairment on closed driving courses, the overall finding is that the more complex the task required when driving, the greater the impairment produced by alcohol – with the level of impairment being greater with increase in alcohol dosage. Whilst participants will often learn to cope with everyday driving demands, they are often unable to cope when an emergency situation arises.

These findings support an earlier review by Chamberlain and Solomon (2002), who found consistent impairment in visual tasks, steering, braking, vigilance and, importantly, information processing and divided attention tasks. They argued the lack of experts challenging these findings indicate the relative consensus of researchers on the impact of alcohol on driving related skills and abilities.

An Australian study by Leung and Starmer (2005) used a simulator to compare the ability of young drivers (18-21 years) and mature drivers (25-35 years) under the influence of a moderate dose of alcohol: to detect the presence of an oncoming vehicle on a straight and curved road; to estimate the point in the road where an oncoming vehicle would have passed the participant's vehicle; and to overtake a vehicle against a steady stream of traffic. Consuming a moderate dose of alcohol impaired all drivers' ability to divide attention but did not have a major impact on decision making in general. All participants' reaction times were increased when asked to detect a vehicle on a curved road.

Calhoun, Carcalho, Astur, and Pearlson (2005) adopted a cutting edge technique to study the effects of alcohol intoxication on driver impairment in a visual perception task and also in a simulated driving task. Functional magnetic resonance imaging (fMRI) was used to study how the neural correlates of alcohol intoxication affect driving performance. The participants were tested at two different BAC levels, low (mean 0.04) and high (mean 0.096) and assessed in regard to: vehicle collisions; near –collisions; number of lane deviations; duration of lane deviations; frequency of exceeding the speed limit; time exceeding speed limit; frequency of instances driving under the minimum speed limit; and time spent driving under the minimum speed limit. In comparison to sober baseline performance, at the low BAC level participants generally controlled their performance by driving slower. At the higher BAC levels, there was a significant difference in the frequency of exceeding the speed limit, and a trend towards increased collisions with other cars. In terms of fMRI results, the authors found that following high alcohol dosage, the cerebellum was highly correlated with an increase in the number of times the speed limit was exceeded.

The contention that these behavioural impairments would lead to increased crash risk, even at the lower BAC levels, is supported by the risk curves provided by the Grand Rapids study and others. While it remains true that most alcohol-related fatalities involve high BAC levels, this is a reflection of the very strong association with crash risk at these levels. This does not change the finding that drivers with a BAC of 0.05 are still driving at heightened risk, particularly with regard to severe crashes.

4.2 Australian experience of lower limits

The experience from Australian jurisdictions suggests that lowering the permissible BAC limit to 0.05 has benefits other than reducing the alcohol-related crashes involving drivers with a BAC between 0.05 and 0.08. Following the introduction of a 0.05 limit:

- Queensland showed a 12% reduction in the number of crash-involved drivers with BACs above 0.15, and an 8% reduction for those in the 0.08 to 0.15 range (Smith, 1988).
- In NSW there was a reduction of 8% in fatal crashes and 7% in serious crashes (Henstridge, Homel, & Mackay, 1997).
- ACT experienced reductions in crash-involved drivers for all BAC levels - 39% for 0.08-0.099, 26% for 0.100-0.149, 31% for 0.150-0.199, and 46% for those 0.200 and above (Brooks & Zaal, 1993).
- In South Australia an existing downward trend in alcohol levels measured by roadside surveys steepened immediately after the adoption of an .05 limit (Kloeden & McLean, 1997).
- In Australia as a whole, the number of drivers detected with excess BACs has declined, as have alcohol-related crashes, since the introduction of random breath testing along with a 0.05 legal alcohol limit. In 1981, 44% of all drivers and riders killed in crashes had a BAC of 0.05 or more; by 1998 this proportion had reduced to 26% (ATSB, 2001). This reduction occurred, not just at the lower levels of alcohol consumption but also at higher levels.

Generally-speaking, most drivers do not show overt signs of alcohol impairment at lower levels. Thus, to capture adequately the benefits of a 0.05 limit requires the possibility of apprehension without the observation of overt behavioural impairment. This requires either random breath testing (RBT) as in Australia, compulsory breath testing (CBT) as in New Zealand, or a system whereby drivers can be stopped and tested on the basis of circumstantial evidence e.g. close proximity to a drinking establishment. This means that the benefits of a 0.05 limit can only be accessed when such testing is introduced. Any evaluation of a blood alcohol limit is at least in part an evaluation of the level used given the enforcement methods used by the Police.

4.3 Other countries' experience of lower limits

The evidence attesting to the benefits of lowered BAC limits from outside Australasia is mixed. This is in part attributable to the different evaluation methodologies and in part to the difficulties experienced in many jurisdictions in effectively enforcing the new limits.

In January 1998 Austria introduced a 0.05 limit along with full enforcement, advertising and rehabilitation programmes. This package led to a significant reduction in reported injury crashes involving drink driving (Bartl & Esberger, 2000).

Hingson (2003) provided an outline of the legislative changes that led to a 0.08 BAC limit being introduced in 44 U.S states during the years 1983-2003, reduced from 0.1. He concluded that overall, lowering of the legal BAC limit led to reductions in road injuries and deaths. In addition to a 6-8% decrease in alcohol-related deaths reported following the introduction of the 0.08 laws, it was predicted that the number of avoided fatalities per year if all states adopted the 0.08 law would be between 400 and 600. Hingson argued that these results are strengthened when the variety of study designs and statistical techniques of the evaluations are taken into consideration.

More recently, Kaplan and Prato (2007) assessed changes in the number of alcohol-related fatalities and the number of alcohol-related crashes over 22 states in the U.S. where the 0.08 BAC limits were enacted. The period of analyses spanned 14 years (1990-2004). Their results showed significant reductions in traffic fatality rates (from 8.4% to 7.9%) and traffic crashes (from 7.7% to 6%). In terms of compliance, it was demonstrated that higher compliance is shown for women and elderly drivers. Interestingly, they noted that gender differences in the results indicated that the laws appear to be more sensitive for the severity of the crashes rather than the actual number of crashes (Kaplan & Prato, 2007). They interpreted these results by arguing that women have a more careful and less aggressive driving style when driving after consuming alcohol, which results in fewer fatalities with respect to the number of crashes overall. Age differences indicated that elderly drivers are less likely to drink to extreme, are more likely to be aware of their impairment when driving and are less likely to drive after consuming alcohol. Finally, single vehicle occupancy rates appear to be less influenced by the 0.08 BAC limit, indicating that law compliance is higher when more than one occupant is involved possibly due to a heightened sense of responsibility for the lives of others. (This has, however, not always been supported by other research, which shows that at least for some younger age groups, additional passengers can be associated with an increase in certain risk behaviours)(Keall, Frith and Patterson (2004).

Bernhoft and Behrensdorff (2002) assessed the impact of lowering BAC limits from 0.08 to 0.05 in Denmark in 1998. The authors examined the injury and fatality rates for the five year period leading to the legislative changes, and the one year period following the new BAC limit. They also compared responses to the Danish National Travel Survey in 1997 with those responses in 1998, to assess whether any behavioural and attitudinal changes towards drinking and driving had occurred since the change in BAC limit. They found statistically significant differences between attitudes and behaviour towards drinking before and after the new legislation. That is, drivers were more likely to either not drink at all or restrict themselves to one drink under the new BAC laws. In contrast, the results showed that the rate of injuries and fatalities slightly *increased* following the new BAC limit. The authors argued that there was insufficient data regarding injuries and fatalities to match the behavioural and attitudinal changes that have occurred following the lowering of the BAC limit.

4.4 Lower limits for young drivers

The increased alcohol-related crash risk of younger drivers has already been noted. In response to this finding, a number of countries have introduced legislation enforcing a lower statutory limit for young or novice drivers. In 1992 Austria lowered the limit for novice drivers from 0.08 to 0.01. This resulted in an exposure-adjusted 16.8% decrease in reported injury accidents compared with experienced drivers (Brooks & Zaal, 1993).

A study by Wagenaar, O'Malley and LaFond (2001) evaluated the effects on drinking and driving of lowered allowable BAC limits for drivers younger than 21 years in 30 US states between 1984 and 1998. It found that the frequency of driving after any drinking and of driving after 5 or more drinks declined 19% and 23%, respectively. Lower BAC limits did not affect the overall amount of drinking or the total number of miles driven. The findings were based on self-reports from a cross-sectional sample of more than 5,000 high school seniors in 30 states surveyed before and after BAC limits were implemented.

Still in the US, Miller, Lestina and Spicer (1997) estimated that introducing a zero alcohol policy for drivers aged under 21 years would result in a benefit:cost ratio of around 11.

A review of evidence on interventions targeting alcohol-impaired driving considered the effectiveness of lower BAC laws for young or inexperienced drivers (Shults et al., 2001). It found that each of the six studies reviewed had reported a post-law reduction in crashes:

- the three studies examining fatal crashes showed reductions of 24%, 17% and 9%
- the two studies examining both fatal and non-fatal injury crashes reported reductions of 17% and 3.8%
- the remaining study examined crashes in which the investigating officer believed that the driver had consumed alcohol, and reported a reduction of 11%.

Two reviews reporting the effects of low BAC limits for young drivers (Chamberlain & Solomon, 2002; Senserrick & Whelan, 2003) show that the most appropriate BAC limit is zero when the beneficial effects on injuries and fatalities involving young drivers are taken in to account. The studies show that benefits of introducing a zero BAC limit include significant reductions in injuries and fatalities, up to a 40% reduction in night time single vehicle crashes, and a 25% reduction in reported driving after consuming alcohol.

5. POLITICAL, SOCIAL AND OTHER FACTORS ASSOCIATED WITH THE ISSUE

Crash risk levels are clearly an important factor in setting the limits for drink driving. However, this consideration also needs to be balanced by what is politically and socially acceptable. Looking at Australia and New Zealand specifically, a 0.05 BAC general limit seems an appropriate compromise between safety and acceptance. In allowing the sensible drinker the possibility of consuming a moderate amount of alcohol before driving, the limit is in broad accordance with the consumption guidelines of health authorities. Consistency between legal alcohol limits for driving and public health advice is likely to have mutual benefits.

From time to time the argument has been put forward that a low limit alienates significant numbers of responsible citizens who currently drive after consuming what they perceive as a responsible amount of alcohol. It is argued that these people will feel themselves to be the unjustified victims of a campaign which should in fact be targeted at "the real drunks on the road”. However, the evidence from Australia and other developed jurisdictions shows no groundswell of opinion against the 0.05 limit after its introduction, and certainly no evidence that its introduction has had any deleterious effect on alcohol enforcement. Information gathered by the New Zealand Police indicates that only 1.2% of drivers in the main drinking hours aged over 20 have BACs between 0.05 and 0.08, with 97.7% under or equal to 0.05.

6. CONCLUSIONS

Determining what is an unacceptable crash risk arising from drink driving is to some extent arbitrary. This is reflected in the different cut-off points chosen by different countries. In Western countries these range from the very conservative 0.02 in Sweden, through 0.05 in Australia and most of Europe, 0.08 in the UK, New Zealand and most States of the USA, to 0.1 in a minority of US States.

Since the early 1980's, most EU member states have lowered their maximum legal BAC limit to 0.05. Only the United Kingdom, Ireland, Italy and Luxembourg still retain a 0.08 limit. Within the EU, Sweden has been the only Member State to adopt a lower limit of 0.02, which became effective in 1990. The European Union has recommended 0.05 to all EU member states as a uniform legal alcohol limit for driving (Breen, 2000).

Although Canada's *Criminal Code* provides for a limit of 0.08, in most provinces and territories it is not permitted to operate a motor vehicle at BACs of more than 0.05 (0.04 in Saskatchewan), but this only becomes a criminal matter where levels exceed 0.08 (Paciocco, 2002). In the USA, the Government has moved to tag federal funding to States to a reduction in their legal alcohol limits from 0.1 to 0.08. As at the end of the 2002 calendar year, 33 US States and the District of Columbia had adopted 0.08 BAC limits.

As a final point in advocating the wisdom of a 0.05 BAC limit, the following statement from Jeanne Breen, Chief Executive of the European Transport Safety Council, is provided:

> "A package of measures is needed in any strategy to reduce casualties in alcohol related crashes. First, the BAC-limit must be set at a level that gives clear guidance to drivers about safe driving practice. Accident analysis supports a limit of 0.5mg/ml [i.e. 0.05] for the general driving population. Experience shows that lowering the BAC-limit to 0.5 mg/ml has a positive effect on the offence rate as well as on injuries due to road crashes. This is a necessary basis for safety campaigns that set out to explain the regulations in order to influence attitudes. Police enforcement and penalties are concomitant elements" (Breen, 1998).

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