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Impact of lowering the legal blood alcohol concentration limit to 0.03 on male, female and teenage drivers involved alcohol-related crashes in Japan

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In June of 2002, a revision to part of the Road Traffic Act drastically increased the penalties for drinking and driving offences in Japan. Most notably, the legal blood alcohol concentration (BAC) limit for driving was lowered from 0.05 mg/ml to 0.03 mg/ml. The rationale for the new lower BAC limit was predicated on the assumption that drinking drivers will comply with the new, lower limit by reducing the amount of alcohol they consume prior to driving, thereby lowering their risk of crash involvement. This, in turn, would lead to fewer alcohol-related crashes. A key limitation of previous lower BAC evaluation research in determining the effectiveness of lower legal BAC limit policies is the assumption of population homogeneity in responding to the laws. The present analysis is unique in this perspective and focuses on the evaluation of the impact of BAC limit reduction on different segments of the population. The chief objective of this research is to quantify the extent to which lowering the legal limit of BAC has reduced male, female and teenager involvement in motor vehicle crashes in Japan since 2002. Most notably, the introduction of reduced BAC limit legislation resulted in a statistically significant decrease in the number of alcohol-impaired drivers on the road in Japan, indicating responsiveness to the legal change among adults and teenagers. In addition, this preliminary assessment appears to indicate that the implementation of 0.03 BAC laws and other associated activities are associated with statistically significant reductions in alcohol-involved motor vehicle crashes. In comparison, the rates of total crashes showed no statistically significant decline nor increase in the period following the introduction of the BAC law, indicating that the lower BAC limit only had an effect on alcohol-related crashes in Japan. The evidence suggests that the lower BAC legal limit and perceived risk of detection are the two most important factors resulting in a sustained change in drinking and driving behaviour in Japan. It is recommended that future research and resources in other countries be focused on these factors as determinants to reduced alcohol-related crashes.

Keywords: Legal blood alcohol concentration limit; Adult and teenage drivers; Alcohol-related crashes; Enforcement of traffic laws; Strict penalties; Deterrence theory

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1. Introduction

In Japan, post-war motor vehicle crash-related deaths exceeded 550,000 in 2000. The death toll far exceeds the combined number of people who were killed in the atomic bombings of Hiroshima and Nagasaki (Desapriya et al. 2002). Road traffic crashes are the leading cause of death by injury and the tenth leading cause of all deaths globally and now make up a significant proportion of the worldwide burden of ill health. An estimated 1.2 million people are killed in road crashes each year and as many as 50 million are injured. An estimated 30 to 70% of orthopaedic beds in developing countries are occupied by victims of motor vehicle-related injury (Pedern et al. 2002).

Road traffic injuries are both predictable and preventable and, for years, reducing the number of traffic-related fatalities and injuries has been a major focus throughout the world. However, it is important to understand how proven road safety interventions and technology can be successfully implemented. A lack of high quality studies, and an awareness of the consequences of road traffic injuries, is lacking among policymakers and the general public (Mohan 2002). One option is to understand and transfer evidence-based interventions that have been successfully applied in one jurisdiction to other jurisdictions, particularly those from developed countries.

Alcohol use is the single most important personal risk factor for fatal injuries, contributing significantly to injury mortality worldwide (McFarland and Haddon 1962, Council on Scientific Affairs 1986, National Institute on Alcohol Abuse and Alcoholism 1994, Koelega 1995). Experimental studies have found a variety of adverse effects resulting from acute alcohol consumption, including affected psychological functions, safety behaviour and operational performance (Koelega 1995). Epidemiological studies have consistently reported that the risk of injury increases with increased blood alcohol concentration (BAC) (Desapriya and Iwase 1998, Zador et al. 2000).

Driving a motor vehicle while under the influence of alcohol continues to be an important public health problem (Desapriya et al. 2002) and is a major cause of motor vehicle crashes and injuries throughout the world. (Rivara et al. 1997).

\[\text{BAC refers to the weight of alcohol (expressed in mg) in a standard volume of blood (usually 100 ml). For example, it is an offence under the Criminal Code in Japan to operate a motor vehicle with a BAC that exceeds 30 mg of alcohol per 100 ml of blood. Because the amount of alcohol in the breath is directly proportional to the amount of alcohol in the blood, BAC is readily (and most often) measured by means of a breath test, i.e. using a ‘breathalyzer’.}\]

2. Laws and road safety

Almost all of the demonstrable gains produced by changing road user behaviour in motorized countries have resulted from traffic safety laws (The Guide to Community Prevention Services 2001). A recent study shows that violation of road traffic law continuous to be a ‘public health problem’ and can often have fatal consequences (Desapriya et al. 2006). Laws by themselves are often not sufficient; the key factor to the effectiveness of a traffic law is a motorist’s perception that he/she runs a high risk of being detected and punished for violating the law. The perception of likelihood of apprehension is a much stronger deterrent than the severity or the swiftness of the penalty (Ross 1982, Desapriya and Iwase 2002, Desapriya et al. 2003). Around the world, enforcement of a law against drinking and driving could reduce drunk driving by 20% (World Health Organization 2004). A recent European study concludes that if all current road safety laws were enforced in the European Union, deaths and serious injuries could be reduced by up to 50% (European Transport Safety Council 1999). Also, comparable benefits have shown promise in new (rapidly) motorizing countries. For example, a recent intervention comprising legislation to impose stiff penalties, media coverage of the new regime and better enforcement achieved a 25% reduction in traffic fatalities in Brazil (Figueiredo et al. 2001).

3. Lowering the legal blood alcohol concentration limit


Similarly, previous research in Australia revealed the effectiveness of enforcement of drinking driving laws and random breath testing (RBT), which has established itself as an outstanding and successful method in preventing
‘alcohol impaired driving’ (Homel 1993). The Australian RBT programme has focused its entire campaign on the basis of the principles of Deterrence Theory, namely, that it must be highly visible, rigorously enforced so as to ensure credibility, sustained and well-publicized (Homel 1993).

A key limitation of previous lower BAC evaluation research in determining the effectiveness of lower legal BAC limit policies is the assumption of population homogeneity in responding to the laws. The present analysis is unique in this perspective and focuses on the evaluation of the impact of BAC limit reduction on different segments of the population. The objective of this study is to determine the effects of lower legal BAC limits on adult males, adult females and youth traffic safety in Japan. The legal limit of BAC for adult and young drivers in most countries is higher than in Japan. Further, the BAC limit for both young and adult drivers in these same countries is not consistent with the best evidence and scientific literature regarding driver impairment and BAC limits.

4. Brief overview of 2002 lower blood alcohol concentration traffic safety legislation and other penalties

In June of 2002, a revision to part of the Road Traffic Act in Japan drastically increased the penalties for drinking and driving offences. Most notably, the legal BAC limit for driving was lowered from 0.05 mg/ml to 0.03 mg/ml. Motorists convicted of drinking and driving may be sentenced to up to 3 years in prison and fined up to 500 000 Yen (US$4250). They can have administrative penalties imposed, such as licence suspension or revocation, and penalty points according to the range of alcohol concentration (Imai 2003).

The rationale for the new lower BAC limit in Japan was predicated on the assumption that drinking drivers will comply with the new, lower limit by reducing the amount of alcohol they consume prior to driving, thereby lowering their risk of crash involvement. This, in turn, would lead to fewer alcohol-related crashes, deaths and injuries. In addition, this may lead to fewer drunk drivers on the road. The chief objective of this research is to quantify the extent to which lowering the legal limit of BAC has reduced teenager involvement in motor vehicle crash-related injuries and fatalities in Japan since 2002.

5. Data methods

Data in this study are taken from the Traffic Crash Database, maintained by the Traffic Bureau of the National Police Agency, and Institute for Traffic Accident Research and Data Analysis (ITARDA) (Institute for Traffic Accident Research and Data Analysis 2005) in Japan. The data summarize both fatalities and injuries based on statistics prepared by the National Police Agency and consist of all reported traffic crashes and fatalities that have occurred in Japan since 1960.

In Japan, it is a legal requirement that police report all possible alcohol involvement among drivers in fatal and non-fatal traffic crashes (Institute for Traffic Accident Research and Data Analysis 2000, Anonymous 2001, Desapriya and Iwase 2002). Several studies have found significant relationships between alcohol sales and the number of alcohol-related crashes (Wagenaar 1986, Blose and Holder 1987, McMillan and Lapham 2006). Accordingly, the number of police reported alcohol-related crashes are used in this research. Alcohol-related crashes in Japan are defined as those where the driver’s BAC limit is over 0.03 mg/ml.

One method for measuring the effectiveness of laws that lower BAC limits for drivers is to determine any pre- and post-law changes in which drivers are involved in alcohol-related crashes and alcohol-related traffic violations (Desapriya and Iwase 1996, 2002, Mann et al. 2001, Shultz et al. 2001). This evaluation presents a quantitative analysis of adult male, adult female and adolescent alcohol-related traffic crashes in comparison to trends of non-alcohol involved crashes in Japan for the period 1998 – 2005. These comparisons will enhance understanding of alcohol-related motor vehicle crashes through an examination of the particular drivers who have been shown to be strongly associated with drinking and driving in many jurisdictions in the world (Waller 1974, Ross and McCleary 1983, Richman 1985, O’Malley and Wagenaar 1991, Ostrom and Eriksson 1993, Hingson et al. 1994, Peden et al. 2004).

Data for the following four measures were examined for the years 1998 – 2001 and 2002 – 2005. These two time periods were selected as the ‘before’ and ‘after’ periods during which the law came into effect:


To compute exposure rates, 1998 – 2005 driver licence data were extracted from the ITARDA annual road traffic collision statistics files. For the analyses reported herein, 16 – 19 year old, male adult driver and female adult driver casualty rates per 100 000 licensed drivers between 1998 – 2001 and 2002 – 2005 were compared. Crash rates based on the above three different groups were computed to adjust for changes in driver licence data over the years 1998 – 2005. To facilitate comparisons with other
international traffic safety evaluation studies, the present analyses were similar to those used in other North American jurisdictions (Ulmer et al. 2000, Foss et al. 2001, Shope et al. 2001).

It is also important to consider whether any changes in alcohol-related crashes among the three different groups may have been due to general trends in crash likelihood, rather than to the lower BAC legislative intervention introduced in June 2002. To control for these general crash trends, 16 – 19-year-old, male adult and female adult driver crash rates were compared with the total motor vehicle crash rates in Japan. It was hypothesized that non-alcohol involved injury crash rates would not be affected by the 2002 lower BAC limit legislation but would be influenced by other factors that may have affected crash rates (e.g. economic factors, special traffic safety initiatives or varying levels of enforcement).

For each of the four measures, the proportion of alcohol involvement experienced ‘before’ June 2002 (the 0.03 BAC law) was compared to the proportion of alcohol involvement experienced ‘after’ June 2002. Crude risk ratios (RR) and 95% confidence interval (CI) were calculated using the standard methods for case–control studies as outlined by Breslow and Day (1980). RR and 95% CI and differences between proportions of alcohol-related motor vehicle crashes with total motor vehicle crashes were calculated using logistic regression utilizing the Statistical Package for the Social Sciences, version 13 (SPSS Inc., Chicago, IL, USA). Descriptive analyses of alcohol-related crashes and total motor vehicle crashes, together with RR and 95% CI were computed. A $\chi^2$ test was used to analyse the trend between arrests and convictions for alcohol-impaired driving and non-alcohol-related traffic violations.

6. Results

Trends describing drinking and driving traffic violations (teenage and adult drivers) and total traffic violations are presented in table 1. A casualty rate per 100 000 licensed drivers was used to control for crash exposure and population increases. Estimated rates for teenage adult male and adult female driver casualties before and after the introduction of the 0.03 BAC law are presented in table 2.

The theory of deterrence through criminal law enforcement has determined the major system of public responsibility for road safety in Japan. It is argued that if punishment for drinking and driving is swift, certain and tough, the rate of occurrence will be correspondingly low. After 2000, the number of arrests for alcohol-related traffic violations declined steadily and became significantly lower after the introduction of the BAC law in 2002. In comparison, arrests for all other traffic law violations steadily increased after 2002 as a result of extensive enforcement of traffic laws in Japan, and police officers were active in arresting drivers for possible traffic violations. This clearly demonstrates that the decreased trend of drunk driving is not merely due to a lack of police enforcement activities in Japan since 2002.

Table 1. Comparison of arrests for alcohol-related traffic violations with total non-alcohol traffic violations in Japan 2000 – 2005.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total arrests for driving under influence of alcohol</th>
<th>Teenage arrests for driving under influence of alcohol</th>
<th>Arrest for all other traffic violations*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>246 260</td>
<td>6492</td>
<td>7 882 785</td>
</tr>
<tr>
<td>2001</td>
<td>214 482</td>
<td>5392</td>
<td>7 774 398</td>
</tr>
<tr>
<td>2002</td>
<td>203 677</td>
<td>5838</td>
<td>7 791 587</td>
</tr>
<tr>
<td>2003</td>
<td>168 642</td>
<td>4821</td>
<td>8 106 728</td>
</tr>
<tr>
<td>2004</td>
<td>146 954</td>
<td>3839</td>
<td>8 505 919</td>
</tr>
<tr>
<td>2005</td>
<td>136 136</td>
<td>3062</td>
<td>8 939 678</td>
</tr>
</tbody>
</table>

*Alcohol-related traffic violations are excluded. $\chi^2 = 7462.09; p < 0.001.$

Table 2. Comparison of driver licence-based estimates for alcohol-related crashes with total motor vehicle crash rates before and after 0.03 BAC limit law in Japan.

<table>
<thead>
<tr>
<th>Category</th>
<th>Period</th>
<th>Rates</th>
<th>RR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol related crashes – Driver licence-based estimates per 100 000 licence drivers (16 – 19 year olds)</td>
<td>1998 – 2001</td>
<td>419.83</td>
<td>0.60</td>
<td>0.52 – 0.71</td>
</tr>
<tr>
<td></td>
<td>2002 – 2005</td>
<td>255.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol related crashes – Driver licence-based estimates per 100 000 licence drivers (adult males)</td>
<td>1998 – 2001</td>
<td>187.00</td>
<td>0.66</td>
<td>0.53 – 0.83</td>
</tr>
<tr>
<td></td>
<td>2002 – 2005</td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol related crashes – Driver licence-based estimates per 100 000 licence drivers (adult females)</td>
<td>1998 – 2001</td>
<td>83.74</td>
<td>0.65</td>
<td>0.46 – 0.92</td>
</tr>
<tr>
<td></td>
<td>2002 – 2005</td>
<td>55.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total motor vehicle crashes – Driver licence-based estimates</td>
<td>1998 – 2001</td>
<td>4,759.08</td>
<td>1.01</td>
<td>0.97 – 1.05</td>
</tr>
<tr>
<td></td>
<td>2002 – 2005</td>
<td>4,849.64</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BAC = blood alcohol concentration; RR = risk ratios. Source: Institute for Traffic Accident Research and Data Analysis.
7. Discussion

This study compared motor vehicle traffic crashes before (1998 – 2001) and after (2002 – 2005) the introduction of the 2002 0.03 BAC legislation in Japan, in order to determine the effect of the law on the rates of alcohol-related crashes. Since the introduction of the 0.03 BAC law, statistically significant decreases were observed in alcohol-related crashes among 16 – 19-year-old and adult male and female drivers. Following the enactment of the lower BAC limit law in Japan, there was a 64% reduction in teenager involved alcohol-related crashes, as well as a 50% and 52% reduction in adult male and female involved alcohol-related crashes, respectively.

In comparison, the overall rates of motor vehicle crashes remained fairly stable during the period following the introduction of the BAC law. Most notably, the introduction of reduced BAC limit legislation resulted in a statistically significant decrease in the number of alcohol-impaired young and adult drivers on the road in Japan, indicating responsiveness to the legal change among both of these driver groups.


A US study by Wagnaar et al. (2001) found that in the first 30 states to adopt lower BAC laws, relative to the rest of the nation, there was a 19% decline in the proportion of people younger than 21 years who drove after any drinking and a 23% decline in the proportion who drove after five or more drinks. A recent review of evaluations of BAC limit policy changes (Zwerling and Jones 1998) has been consistent in finding reduced drinking and driving among young drivers, regardless of geographic areas, time, varying law specifications and differing study designs; further strengthening the argument for the effectiveness of lower BAC limits for young drivers. Dee (2001) found that the adoption of lower BAC laws was associated with a 7% decrease in fatal traffic crash rates.

Since 2002, drinking and driving laws have become more prevalent, and enforcement of the laws has become more extensive. In addition to a low BAC limit, Japan has introduced strict laws aimed at reducing driving while intoxicated (DWI). Driving under the influence of alcohol has a monetary fine of 300 000 Japanese Yen (US$2500). Driving while impaired by alcohol has a monetary fine of 500 000 Japanese Yen. With the amendments of DWI laws in Japan in June 2002, increased penalties upon conviction raised the legal costs of DWI.

A study by Chaloupka et al. (1993) concluded that drinking and driving laws associated with severe sanctions can be effective deterrents to drinking and driving. Research confirms that consistent enforcement helps to reduce impaired driving, as well as reinforcing the message that drivers must be responsible for their actions (Ross 1982, Desapriya and Iwase 1996). An aggressive law enforcement programme supported by laws and regulations and an effective education effort will result in changed community norms (Snortum et al. 1988, Berger et al. 1990, Desapriya and Iwase 2002) and changes in motorists’ behaviours.

Since 2001, the Japanese media has launched an education campaign about the new BAC law and associate penalties, while emphasizing to communities that traffic safety is a quality-of-life issue. When legal BAC limits for drivers are lowered, the need to educate the public about these changes becomes apparent. Research indicates that public education to promote awareness of the new legal BAC limit can enhance the legislation’s effectiveness (Blomberg 1992). One recent systematic review found strong evidence that mass media campaigns are effective in reducing alcohol-impaired driving and alcohol-related crashes if they are carefully planned, well-executed and attain adequate audience exposure and if they are implemented in conjunction with other ongoing prevention activities, such as enforcement of laws against alcohol-impaired driving (Elder et al. 2004). As many research studies have shown, changes in drinking and driving behaviour that lead to a change in risk and a reduction in crashes are contingent upon people’s support, knowledge and understanding of the new law (Shultz et al. 2001, Carpenter 2005).

Previous evaluation studies have utilized both qualitative or quantitative analyses and researchers continue to be concerned about the changes in public perception and attitudes towards drinking and driving resulting from enactment of new policies on drunk driving. Since the deterrence proposition depends on public perception, it could be assumed that public perception is evolving with positive support for deterrence (Ross 1982, Homel 1993, Desapriya and Iwase 1996). A recent opinion poll has shown that in general, Japanese society assumes a highly restrictive attitude toward drunk driving. For instance, a national poll conducted in October 2006 by the Cabinet Office asserts this moral consciousness. A total of 73% of those surveyed called for more severe punishment of drunk drivers and 44% favoured similar penalties for individuals who choose to ride in vehicles driven by drunk drivers (Anon 2007).

The National Police Agency identifies and shares knowledge of best practices and what is effective in traffic safety...
with all prefectural police departments throughout Japan. They continue high visibility enforcement efforts as RBT (i.e. tests conducted without cause) are legal in Japan and provide greater latitude for enforcement.

8. Conclusions

Alcohol-impaired driving is a major cause of adolescent and adult male and adult female injuries in most motorized countries and identification of programmes and policies that prevent or reduce injuries is thus a public health priority. Since 2002, a reduction in alcohol-related motor vehicle crashes in Japan represents a public health success. Comparisons between measures of driver involvement in alcohol-related crashes, and total crashes, in Japan after implementation of 0.03 BAC legislation, along with other penalties and extensive enforcement, suggest that statistically significant decreases occurred following implementation of the legislation. Lowering the legal limit to 0.03 sends a message to the driving public that impaired driving is unacceptable and laws against it will be enforced. The 0.03 legal limit is reasonable and has the potential of avoiding thousands of motor vehicle crashes and related deaths and injuries if it is implemented with other effective, deterrent-based policies.

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