Severity of alcohol-related motor vehicle crashes in British Columbia: case–control study

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The objective of the present study was to compare the injury severity and vehicle damage severity rates of alcohol-related crashes with rates of non-alcohol-related crashes in British Columbia (BC). Injury severity rates and vehicle damage severity rates were taken from 2002 Insurance Corporation of British Columbia traffic collision data. The data were computed in order to compare the differences in injury severity and vehicle damage severity rates of alcohol-related vs. non-alcohol-related motor vehicle crashes. Case–control methods were used in this study to analyse the risk of alcohol-related crashes compared to non-alcohol-related crashes in BC. Odds ratios (OR) and 95% CI were calculated to estimate relative risks. In the case–control analysis, the risk of fatal collision was increased for those drinking and driving compared with those driving sober (OR 4.70; 95% CI 3.15 – 7.01). Risk of injury collision was increased for those drinking and driving compared with those driving sober (OR 1.32; 95% CI 1.19 – 1.37). Importantly, the risk of vehicle damage severity was increased for those drinking and driving compared with those driving sober (OR 4.24; 95% CI 3.70 – 4.86, severely damaged vehicles OR 1.98; 95% CI 1.77 – 2.21). The study reinforces existing literature to suggest that current evidence is sufficient to show an increased risk of injury and fatality to drivers and occupants in alcohol-related crashes. This paper not only emphasizes this well-known relationship, but also such consequences as increased vehicle damage severity. The connection between drinking and severity of motor vehicle crashes is popularly believed and has now received substantial scientific support. There is strong justification for injury prevention experts and policy-makers to step up motor vehicle crash injury prevention advocacy by implementing evidence-based policies to reduce rates of alcohol-impaired driving in the province of BC. Most unintentional injuries in BC are related to motor vehicle crashes. Significant improvements can be made in these statistics by: increasing the use of occupant protection (safety belt and child restraint seats); reducing alcohol-related injuries through multiple strategies including corrections in the physical environment, extensive enforcement of drinking and driving laws and health promotion/education.

Keywords: Risk factors; Motor vehicle crashes; Drinking and driving; Injuries; Fatalities; Vehicle damage severity

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1. Introduction

Alcohol use is the most important personal risk factor for fatal injuries, contributing to a considerable number of all injury mortality in the world (Council on Scientific Affairs 1986). Recent estimates of national economic loss due to road traffic injuries show that these range from 1–2% of the gross domestic product of nations around the world (Jacobs et al. 2000). The health-related, social and economic costs of alcohol abuse may be as high as $8.6 billion, of which $1.3 billion is spent on direct health care costs in Canada (Single et al. 1996). About 10% of premature death in Canada is caused by hazardous drinking, and more than 38% of fatal traffic crashes involve alcohol (Transport Canada 2002). Developed nations have decided that driving under the influence of alcohol is sufficiently hazardous to society to make this behaviour a serious criminal offence. Alcohol-impaired driving is the single leading criminal cause of death in Canada (Asbridge et al. 2004). Nearly one-fourth of the roughly 460 fatal automobile crashes in British Columbia (BC) each year are alcohol-related, meaning that someone in the crash, usually the driver, is intoxicated. Approximately 7% of Canadians report driving in the past year after drinking three or more drinks. About 1350 people die in alcohol-related collisions in Canada each year. The victims include not only the drunk drivers themselves but also innocent passengers (children) in the drunk drivers’ vehicles, people in other vehicles and pedestrians (Quinlan et al. 2000, Asbridge et al. 2004). Quinlan et al. (2000) have calculated recently that 28.1% of all child passenger fatalities (age 0–14 years) between 1985 and 1996 in the United States involved a drink driver. A recent article shows that, in BC, percentages of people aged 12 years or older who had been passengers in a drinking driver’s vehicle were significantly higher than the average of the six reporting provinces in Canada (Claudio 2005).

Despite the knowledge that alcohol use increases the risk of motor vehicle crashes (MVCs), there is little known about the actual profiles of alcohol-related MVCs and injuries in BC. Many previous studies have shown that driving under the influence of alcohol and/or certain illicit or medicinal drugs increases the risk of a crash. However, data with regard to whether alcohol is actually associated with a more severe crash are sparse. Some studies have shown that the use of alcohol or drugs has no clear association with the severity of the MVCs (Barbone et al. 1998, Marquet et al. 1998, Neutel 1998, Movig et al. 2004). The effects of alcohol use on MVC severity are therefore controversial (Li et al. 1997).

In relation to road safety, it is not only important to prevent crashes, but also to gain insight into the specific factors governing morbidity and mortality. The objective of this study was to evaluate the relationship between alcohol use and the severity of the MVC in BC.

2. Data and methods

Alcohol-involved crash data were taken from 2002 Insurance Corporation of British Columbia (ICBC) traffic collision data (Insurance Corporation of British Columbia 2002). This database contains information on personal factors, injury type and anatomical site injured for each person and restraint use, as well as information on vehicle damage severity, time of the crash, road conditions and cause of crash and crash characteristics. The ICBC data include several variables regarding the use and availability of restraint systems within each vehicle, for each occupant. Manual (or active) belt use is defined as the use of shoulder belt, lap belt, lap and shoulder belt or any combination of belt use with a child safety seat. The alcohol-related injury data included in this study involved all injury crashes, not just serious ones since information on injury severity in a crash is not recorded by the police in BC. The police reports describe the type of crash, the characteristics of each vehicle and information about any injuries to occupants of each vehicle. For all occupants the police specify (for what appears to be the most important injury) the location (head, abdomen, etc.) and nature of the injury (concussion, laceration, fracture, etc.). The inclusion/exclusion criteria for alcohol-related crashes were all crashes coded by police as ‘alcohol involved’ other than alcohol-involved pedestrian and bicyclist crashes. Crashes in which either vehicle was licensed to another jurisdiction were excluded. Crashes where either vehicle was a truck, bus or other large or commercial/construction vehicle were also excluded. The inclusion/exclusion criteria for control crashes were two-vehicle crashes of all other types, selected at random after excluding crashes as described previously. Police also specify the level of damage to each vehicle, from the most severe (e.g. ‘demolished (write-off)’) to minor scratches or no visible damage. Severity is measured by material damage and fatal injury to anyone involved in the crash. Case–control methods were used in this study to analyse the risk of alcohol-related crashes compared to non-alcohol-related crashes in BC. Overall fatal injury and specific types of injury were compared for alcohol and control crashes using logistic regression to estimate the odds ratio (OR), i.e. the odds of fatal injury and type of injury in alcohol-related crashes relative to control crashes. The OR indicates the risk of fatal injury, injury types and vehicle damage whilst driving under the influence of alcohol compared with the risk whilst driving sober.
3. Results

3.1. Number of crashes

Altogether, there were 83,565 vehicles involved in 47,495 police-reported crashes in the database that was received. Of these, 4,600 (10%) crashes were described as ‘alcohol involved crashes’ by the police. After limiting the choice to only alcohol-related crashes and excluding pedestrian, bicyclist, out-of-province vehicles, trucks, construction, commercial vehicle, buses, etc., there were 3,990 alcohol-involved crashes.

3.2. Driver age and gender

In the alcohol-related crash category sample demographics were distributed as follows: 80% were male and 20% were female; the age of those who had alcohol-related crashes ranged from 15 to 88 years, with a mean age of 34.4 (SD 13.5) years.

In the non-alcohol crash category sample demographics were distributed as follows: 57% were male and 43% were female; the age of those who had MVCs ranged from 14 to 95 years, with a mean age of 39.5 (SD 17.7) years.

With regard to age, 6.8% of the drink drivers were under the legal age of 19 years. Young male drivers were predominantly responsible for alcohol-related crashes. Alcohol involvement in crashes declined with age, but less steeply for females. The female drinking drivers were about equally distributed from 16–20 years up until age 41–45 years. After the age of 45 years, the likelihood of alcohol involvement in crashes decreases.

3.3. Time of occurrence

Alcohol-related casualty collisions are more likely to occur on weekends (Friday, Saturday, Sunday) than on weekdays. In 2002, approximately 60% of all alcohol-related injury collisions occurred on weekends. Likewise 57% of all alcohol-related fatal crashes occurred on weekends. The peak occurrence for alcohol-related injury collisions was between the hours of 10:00 pm and 3:00 am. Crashes occurring during this period accounted for about 42.3% of all alcohol-related casualty collisions.

3.4. Relationship between contributing factors

By examining the concurrence of contributing factors, the following relationship can be observed: ‘Alcohol involvement’ most often occurs together with ‘driving without due care’ (877 cases) and with ‘unsafe speed’ (639 cases).

A total of 83% of sober drivers used seat belts. These statistics are consistent with provincial rates. It is very clearly shown in table 1 that drivers are less likely to use restraints when they have been drinking. Traffic safety research literature shows that seat belts reduce the chance of fatal injury by half in passenger cars. It is a great tragedy that 17% of alcohol-impaired drivers fail to buckle their seat belts. Since the ‘unknown’ category for type of restraint use is as high as 30%, an exact number for the ‘no restraint use’ category cannot be provided. The unknown category of seat belt use is higher in alcohol-involved crashes than non-alcohol-involved crashes.

Table 2 shows that the severities of driver/passenger injuries are more significant in alcohol-related than in non-alcohol-related crashes in BC. Other than whiplash injuries, all other injury types are significant and higher in alcohol-related crashes than in non-alcohol-involved crashes.

The analysis in tables 3 and 4 shows that vehicle damage severity, passenger fatal injury and driver fatal injury is higher in alcohol-related crashes than in crashes involving sober drivers. Therefore, this case–control study confirms that alcohol-impaired driving is a risk factor for both fatal injury and vehicle damage severity in MVCs.

4. Discussion

The present study reinforces existing literature to suggest that current evidence is sufficient to show an increased risk of injury and fatality to drivers and occupants in alcohol-related crashes. In addition, this paper emphasizes not only...
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greater fatal injuries (House et al., 1997). Associated with more serious vehicle body damage and agreement with those studies that conclude that alcohol is present in MVC victims (House et al., 1997). Epidemiological studies of MVCs have found that, when other relevant variables are considered, serious and fatal injuries increase in the presence of alcohol, and that alcohol increases early death in MVC victims (House et al., 1982, Waller et al., 1997).

Some studies conclude that alcohol use does not increase fatal injury and vehicle body damage (e.g. Li et al., 1997, Barbone et al., 1998, Marquet et al., 1998, Neuteil 1998, Movig et al., 2004). Instead, the present results are in agreement with those studies that conclude that alcohol is associated with more serious vehicle body damage and greater fatal injuries (House et al., 1982, Council on Scientific Affairs 1986, Single et al., 1996, Waller et al., 1997, Asbridge et al., 2004). This connection between drinking and severity of MVCs has become more popular and has now received substantial scientific support. There is thus strong justification for the injury prevention experts and policy-makers to step up their unintentional injury prevention advocacy by implementation of evidence-based policies to reduce rates of drinking and driving in the province of BC.

As mentioned below ‘Alcohol involvement’ most often occurs together with ‘unsafe speed’ (639 cases). The problem of excess and inappropriate speed is the most common and the most severe road safety problem. Both crash frequency and crash severity are further increased when excess speed is combined with alcohol use. Excess speed combined with alcohol consumption is by far the most dangerous road traffic behaviour in BC.

General deterrence depends on drivers knowing and being motivated to avoid the consequences of drinking and driving (Ross, 2000). However many British Columbians are unaware of the consequences of drinking and driving and about half of the respondents of the ICBC survey in 2002 were unaware of the driving suspension length for a first conviction under criminal law (Government of British Columbia, 2003). Success of public information campaigns in the prevention of drinking and driving is largely supported by a recent systematic review (Elder et al., 2004). The BC government should therefore proceed with intensive drinking and driving counter-advertising and education campaigns. Drinking-driving countermeasures have clearly demonstrated effectiveness in reducing alcohol-related traffic injury, fatality and property damage in the majority of countries in the world but have not been as fully or as widely applied in BC.

The risks of a fatal crash whilst driving at the current legal limit are alarmingly high. This is not surprising, considering that the average male would need to consume about six standard drinks without food in 90 minutes to reach the current adult blood alcohol limit of 80 mg/100 ml (Desapriya, 2004). Most BC residents agree that drinking and driving is a serious problem but too many also believe that a small amount of alcohol will not impair their driving performance. In the same survey, 11.3% of BC drivers reported drinking whilst impaired at least once in the past 2 months. This translates to a minimum of 2.5 million trips per year by drivers whose blood alcohol level exceeds the legal limit (Government of British Columbia, 2003).

One recent study in the Canadian Journal of Emergency Medicine found that only 11% of intoxicated drivers who were admitted to BC hospitals for crash-related injuries were convicted of drinking and driving (Purssell et al., 2004). The BC convictions for drinking and driving offence data show that 33% of the 24 hour suspensions given out in 2002 were preceded by previous suspensions (Government of British Columbia, 2003). Early arrests may thus present an important opportunity to decrease the risk of death from future alcohol-related crashes and may facilitate secondary prevention efforts in BC.

Since a substantial proportion of the persons arrested for drinking and driving are repeat offenders in BC and may be alcohol dependent, it is further recommend that legal sanctions against drinking and driving be linked with programmes to identify and treat alcoholic drivers. Such programmes may be particularly effective for younger drivers, whose drinking behaviour is likely to be more sensitive to environmental influences (Vaillant, 1983,

Table 3. Comparison of injuries and fatalities in alcohol-related crashes vs. non-alcohol-related crashes.

<table>
<thead>
<tr>
<th>Injuries and fatalities</th>
<th>Alcohol-related crashes</th>
<th>Non-alcohol-related crashes</th>
<th>OR</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total injuries</td>
<td>2154</td>
<td>2442</td>
<td>1.32</td>
<td>1.19 – 1.37</td>
</tr>
<tr>
<td>Total fatalities</td>
<td>100</td>
<td>32</td>
<td>4.70</td>
<td>3.15 – 7.01</td>
</tr>
<tr>
<td>No injuries</td>
<td>4373</td>
<td>6581</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OR = odds ratio.

Table 4. Comparison of vehicle damage severity in alcohol-related crashes vs. non-alcohol-related crashes.

<table>
<thead>
<tr>
<th>Vehicle damage severity</th>
<th>Alcohol-related crashes</th>
<th>Non-alcohol-related crashes</th>
<th>OR</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write-off</td>
<td>892</td>
<td>475</td>
<td>4.24</td>
<td>3.70 – 4.86</td>
</tr>
<tr>
<td>Severe</td>
<td>1180</td>
<td>1344</td>
<td>1.98</td>
<td>1.77 – 2.21</td>
</tr>
<tr>
<td>Moderate</td>
<td>1115</td>
<td>2107</td>
<td>1.19</td>
<td>1.07 – 1.33</td>
</tr>
<tr>
<td>Light and no damage</td>
<td>923</td>
<td>2086</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OR = odds ratio.
Moskowitz 1989). Physicians may play a key role in the process by assessing and treating alcohol abuse in their patients. Guidelines recently developed by the American Medical Association (2004) highlight the responsibility of physicians to promote safe mobility as a basic aspect of maintaining and protecting their patients’ health and well-being.

Available literature on traffic safety shows that seat belts and air bags significantly reduce morbidity and mortality following MVCs. Traffic safety research literature shows that seat belts reduce the chance of fatal injury by 60% in passenger cars (Rivara et al. 1999, Cummings and Rivara 2004). The present study shows very clearly that drivers are less likely to use restraints when they have been drinking. BC provincial average seat belt use is 79.7%. This rate is lower than the national average of 85%, as estimated from the Transport Canada survey of seat belt use in 2002 – 2003 (Transport Canada 2004). In 2002, 82% of the drivers in casualty collisions without restraints were injured or killed whilst only 52.1% who used the standard lap and harness system were injured or killed (Insurance Corporation of British Columbia 2002). Not using a safety belt is one of the major risk factors for fatalities and injuries to motor vehicle occupants. The two most effective strategies for increasing seat belt use have been the passing of primary seat belt laws and campaigns to enforce these laws and publicize their enforcement. Primary seat belt laws allow a law enforcement officer to stop and ticket a driver for not wearing a seat belt. Educational campaigns are needed to influence public opinion and policy-makers before the implementation of primary seat belt enforcement law in BC.

Without police enforcement, legislation will have little impact on the road safety situation. BC’s Traffic Services Study in 2000 surveyed police in order to identify reasons for their reluctance to recommend more severe criminal charges. Three primary reasons surfaced: 1) the time required to process the charge; 2) insufficient staff to process the impaired driver; 3) the belief that the impaired driver would not be found guilty or would plead to a lesser offence, such as careless driving. In fact, the process involved in charging an individual with impaired driving is so complex and time-consuming that police officers often issue a violation ticket or a 24-hour prohibition instead of an impaired driving charge (Government of British Columbia 2003). Convicting drivers for not abiding by the traffic rules has several beneficial effects for the community. The two most obvious of these are that dangerous drivers are removed from the road for a significant period of time and that conviction of these drivers probably serves as a deterrent to others. The available systematic reviews show that enforcing traffic laws efficiently reduces subsequent motor vehicle-related crashes (Shults et al. 2001).

This is supported by clear evidence that sustained police attention to drink drivers has an effect in lowering the number of alcohol-related casualties. In their empirical study Reelmeier et al. (2003) highlighted the fact that extensive traffic-law enforcement effectively reduces the frequency of fatal MVCs in countries with high rates of motor vehicle use. This strategy is widely acknowledged as critical in preventing traffic crashes (Shults et al. 2001, Desapriya and Iwase 2002, Reelmeier et al. 2003, Transport Canada 2004).

5. Conclusions

The results of this study show a significantly increased risk of mortality, morbidity and vehicle damage severity among drunk drivers involved MVCs in BC. From a public health and traffic safety perspective, this implies a need for developing and implementing better prevention strategies. Alcohol-related motor vehicle injuries are a major public health problem. They are a primary cause of death and injury in Canada as well as BC and result in a substantial loss of productive life. These injuries and fatalities have serious social and economic consequences for the injured individual, their families and society. Given the large numbers of people who continue to die in alcohol-related traffic crashes, it remains imperative that public health professionals and others interested in traffic safety continue to maintain a strong focus on drinking and driving prevention efforts. Promoting healthy lifestyles enables individuals and communities to control and improve their health and to reduce injuries. Finally, MVC prevention must be seen in the broader context of public health, healthy public policy and media portrayals of health and lifestyle choices.

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