Alcohol and injury among attendees at a New Zealand emergency department
Gayl Humphrey, Sally Casswell and Dug Yeo Han

Abstract

Aim This study investigated the role of alcohol in injury cases among patients attending an emergency department in Auckland during December 2000.

Methods A random sample of patients was interviewed and breath tested in the emergency department. Interviewing took place continuously for a three-week period. Using a case-crossover design the causal role of alcohol was assessed.

Results Thirty five per cent of injured patients reported having consumed alcohol prior to sustaining their injury; this is a high proportion compared with overseas research. Males and the under 30 years age group were over-represented in both alcohol-related and non alcohol-related injury cases. The risk of sustaining an injury was 2.8 times greater when alcohol was consumed. The median amount of self-reported absolute alcohol consumed prior to alcohol-involved injury was 103 ml (equivalent to about seven cans of beer), with the lower quartile at 37 ml and upper quartile at 246 ml. For injury cases reporting consumption of alcohol prior to their injury event, there was a cumulative risk of 1.14 for each 30 ml of absolute alcohol (two cans of beer) consumed. There were no differences between the quantity of alcohol consumed by males and females or younger and older participants. Of those with blood alcohol concentration (BAC) readings obtained from breath samples, 51 % had BAC reading equal or greater than 0.300 mcg. Violence was found to be the cause of 17% of the injury cases and alcohol was reported as involved (victim and/or perpetrator) in 79% of these cases. Injury involving violence occurred most often in a public place or on a licensed outlet.

Conclusions This is the first study of alcohol involvement in injury presenting to an emergency department in New Zealand. Findings indicate that a relatively high proportion of injury cases requiring emergency department treatment were alcohol-related and that the risk of an injury occurring was significantly increased by consumption of alcohol.

There is comparatively little research in New Zealand that examines the role of alcohol in injury occurrence, and none that clearly documents the level of alcohol’s involvement. In a study of New Zealand rugby injury, Quarrie et al found 14% of males and 8% of females participating reported that injuries they sustained in the previous 12 months were the result of their drinking. The study also found that heavier drinking was the norm, with 61% of males and 38% females consuming six drinks or more in one session at least weekly. Langley et al used the New Zealand Health Information Service database to examine the incidence of death and hospitalisation from assault occurring in and around licensed premises. In spite of some recording inconsistencies, the study found that when place of assault was recorded, 10% of these assaults took place in or around licensed premises, 17%
involved people under 20 years of age, and males were over-represented in all assault figures.

There have been no investigations of alcohol involvement in patients with an injury presenting to the emergency department in New Zealand, but there have been studies in Australia, 3 the USA and Canada, 4,5 Mexico and Spain, 6,7 Finland, 8 and the United Kingdom, 9 which have shown that between 10% and 18% of injury cases attending emergency departments were alcohol-related. Studies have also shown that young people and males were over-represented in these figures, 10,11 and that alcohol-related injury patients were more likely to report heavy typical consumption patterns, to have experienced prior alcohol-related injury, and were unlikely to use health care services other than the emergency department (ED). 12

The aim of this study was to describe the proportion and context of alcohol-related injury cases among injury cases attending the emergency department during the study period. It used a case-crossover design to assess the causal role of alcohol in the injury. This study was undertaken as part of a World Health Organisation (WHO) international collaborative study investigating alcohol involvement in injuries presenting to EDs.

Methods

Injury/poisoning (subsequently referred to as injury) presentations to the Auckland ED were surveyed continuously twenty four hours a day in the first three weeks of December 2000. The ED computer admission record and ED staff were consulted to identify all injury attendees. Details of all injured patients (age, gender, triage code, injury complaint, presentation time) attending the ED during the study period were recorded in a case log book. Interviewers approached all injured patients, informed them of the study, provided them with an information sheet and then asked the screening question to determine eligibility.

Eligible participants were determined as those: injured within six hours of arrival time to the ED; presenting for first treatment of their injury; and able to give informed consent. Every second eligible participant was invited to participate. This systematic sample frame was chosen to allow for busy periods within the ED and to minimise missed cases. If the patient agreed to participate but was perceived to be too intoxicated to answer the questionnaire in detail, provision was made to delay its administration until a more appropriate time.

Breath samples were collected using an Alcotec AR1005 breathalyser that was calibrated and validated according to the manufacturer’s specifications.

Participant data were collected directly from participants through an interviewer-led questionnaire. Information collected included: demographics; a description of the injury event; involvement of violence; injury event location; alcohol consumption prior to injury; location(s) at which alcohol was consumed; quantity of alcohol consumed on a typical drinking occasion; and frequency of alcohol consumption.

Specific case-crossover methodology questions included alcohol consumption one week previous; if the injury event interrupted the drinking occasion; and an estimate of how much more alcohol would have been consumed if the injury event had not occurred.

Three measures of alcohol involvement were used: blood alcohol concentration (BAC) measured using the Alcotec AR1005 breathalyser; participant self-report of alcohol consumption; and a clinical observation of intoxication judged by the ED’s senior triage nurses at first contact with the patient. (Agreement analysis between the observational assessment and BAC obtained from the breathalyser will be reported on separately.) An alcohol-related injury was determined by a self-report that alcohol was consumed prior to the injury occurring.

To check for breathalyser reading reliability, a sample of similar reading results were selected, and each participant’s alcohol consumption characteristics examined (eg, amount of alcohol consumed, time between breath sample and last drink etc) for comparability. If discrepancies were found, five readings before and after were also selected and similarly checked for comparability.
Frequency analysis was used to estimate the proportions of alcohol-related injuries compared with nonalcohol-related injuries. The case-crossover design was used to assess the risk of injuries following alcohol consumption. In this design, participants acted as their own controls between periods of exposure and non-exposure to injury, therefore controlling for potential confounding factors due to participant characteristics. Thus, the exposure categories were obtained by dichotomising within the hazard period (injury) and control period (one week earlier). The relative risk and its 95% confidence interval were calculated to establish the risk of experiencing an alcohol-related injury. Logistic regression was used to estimate the effect of different levels of alcohol quantities on the risk of an injury. The use of this model does not violate the proportional odds assumption ($p = 0.33$), and is commonly used when outcomes can be ordered in nature. The ordinal scale for the amount of absolute alcohol quantity prior to injury was graded from 1 to 3; where 1 was less than 100 ml, 2 was between 100 and 300 ml, and 3 was greater than 300 ml.

For alcohol-related injury cases, three drinking variables were collected and used for analysis: the quantity of alcohol consumed prior to injury occurrence; the quantity consumed at the same time one week prior to injury occurrence; and the quantity consumed on a typical occasion. For non alcohol-related injury cases, two quantity periods were used: alcohol quantity consumed one week prior to injury; and typical alcohol quantity consumption.

**Results**

A total of 273 participants were eligible to participate in this study. Of these, 170 were invited and consented to participate and 166 (61%) completed the procedures, with four (1.5%) incomplete. These four were excluded from the analysis. Of the remaining 103 eligible, 63 (23%) were invited but refused to participate, and 40 (15%) were unable to be invited because they had left the department before being approached by the interviewers (Figure 1).

There were no significant differences in demographic characteristics (age, gender, and ethnicity) between those who participated and those who refused or were missed. There were also no differences in triage code allocation, or the day or time of visit. This is comparable with other ED studies. Males represented two thirds of all the injury presentations and participants were aged between 16 and 90 (median 32 years). Although two thirds of the injuries were experienced by the under 30 years age group there were no significant differences between the demographic variables (age, gender, ethnicity, education, employment, income) by alcohol and non alcohol-related injury.

Blood alcohol concentrations (breath tests) were obtained from 148 (90%) participants. Fifteen participants refused to give a breath sample but agreed to the interview, two participants were found to have a positive BAC reading despite reporting consuming no alcohol before their injury. Of the 107 non alcohol-related injury cases, 94 (88%) supplied a breath sample and 13 (12%) refused to provide a breath sample but agreed to complete the interviewer-led questionnaire. Of those who supplied a BAC, two participants were found to have a positive BAC reading despite reporting consuming no alcohol before their injury.
After reviewing the data according to the quality check procedure, a misread was found to be unlikely and as such these BAC data were included in the analysis.

**Type of injury** Cuts and bruises were the most common injuries for alcohol-related injuries, while cuts, bruises and sprains were the most common injuries for non alcohol-related injuries (Table 1). There were significant differences in injury severity (defined by triage code allocated at admission) between alcohol-related injury and non alcohol-related injury cases ($p = 0.047$), with alcohol-related injury being assessed as more serious.

These injuries reflect those commonly reported for claims by the Accident Compensation Corporation.\(^{16}\)

**Place of injury occurrence and place of last drink** Home (own or others) (34%) and public place (21%) were the two most common locations for sustaining an injury. Injuries in which alcohol was a factor were more likely to occur in the home (29%) and in a licensed outlet (23%), with public place and private vehicles the two next most common locations (21% and 16% respectively) (Table 2).

Table 2 also shows that participants reporting injury location as either a public place (21%) or vehicle (16%) were moderately more likely to have had their last drink
somewhere else. With respect to the other data, there were no significant patterns between injury location and last drinking place.

Similarly, for non alcohol-related injury cases, home (own or other) was the most common location for the injury to occur (33%). Public place (29%) and work place (23%) were the next most common injury locations reported by this group.

Table 1. Alcohol-related and non alcohol-related injury description

<table>
<thead>
<tr>
<th>Injury*</th>
<th>Alcohol-related n (%)†</th>
<th>Non-alcohol-related n (%)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture</td>
<td>8 (10)</td>
<td>17 (12)</td>
</tr>
<tr>
<td>Sprain</td>
<td>9 (11)</td>
<td>28 (19)</td>
</tr>
<tr>
<td>Cut</td>
<td>24 (30)</td>
<td>40 (27)</td>
</tr>
<tr>
<td>Bruise</td>
<td>22 (28)</td>
<td>35 (24)</td>
</tr>
<tr>
<td>Burn</td>
<td>0</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Concussion</td>
<td>2 (3)</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Organ</td>
<td>1 (1)</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>11 (14)</td>
<td>16 (11)</td>
</tr>
<tr>
<td>Unknown</td>
<td>2 (3)</td>
<td>6 (4)</td>
</tr>
</tbody>
</table>

*some participants sustained more than one type of injury; †percentages do not total 100 due to rounding

Table 2. Place of injury occurrence and place of last drink

<table>
<thead>
<tr>
<th>Place of last drink</th>
<th>Place of injury occurrence n (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Licensed outlet</td>
</tr>
<tr>
<td>Licensed outlet*</td>
<td>12 (65)</td>
</tr>
<tr>
<td>Home</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Others’ home</td>
<td>0</td>
</tr>
<tr>
<td>Public place</td>
<td>0</td>
</tr>
<tr>
<td>Vehicle</td>
<td>0</td>
</tr>
<tr>
<td>Work place</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>13 (23)</td>
</tr>
</tbody>
</table>

*Kappa = 0.52, 95% CI [0.37, 0.67]

Blood alcohol concentration (BAC) determined by breathalyser The BAC reading range was 0.008 to 1.147 mcg, median 0.3255 mcg. Of the 54 alcohol-related injury cases with positive breath readings, 39 (72%) were over the New Zealand legal BAC limit for driving (>0.04 mcg).

Self-reported quantity of alcohol consumed prior to injury The median of self-reported absolute alcohol consumed by alcohol-related injury participants prior to the injury occurrence, was 103 ml (equivalent to almost seven cans of beer), with a lower quartile of 37 ml (just over two cans of beer), and an upper quartile of 246 ml (16 cans of beer). There were two extreme values reported – 2520 ml and 14 653 ml – the contextual remarks accompanying which reported “a session” (lasting three days) and
“a bash” (of similar duration). Both of these cases reported bottles of spirits as the beverage consumed.

Self-reported typical occasion alcohol consumption Alcohol-related injury cases were more likely to report a frequency of typical occasion alcohol consumption of at least once a week or more (56%) than the non alcohol-related injured participants (38%). This pattern is repeated in frequency of drinking larger quantities (eg, 5–11 drinks (26% vs 17%), and 12 plus drinks (12% vs 7%)) on any one occasion.

Alcohol consumed prior to injury, one week before injury, and typical alcohol consumption Almost half of the alcohol-related injury cases reported that they would typically consume more than the amount consumed on this occasion. The reason given for this was that this drinking occasion was interrupted by the injury event. The median amount that would have been consumed if the injury had not occurred was a further 35 ml, or just over two cans of beer.

To compare whether the amount of alcohol consumed on the injury occasion was different from one week before or that reported as consumed on a typical occasion, the amount that would have been consumed was calculated in order to give an amount reflective of an occasion without an injury. This adjusted amount was then compared with the amount given for one week before and a typical drinking occasion. No significant differences (p = >0.5) were found between injury day alcohol amount, reported last week amount and typical occasion amount.

Alcohol and risk of injury Data on alcohol consumption on day of injury and one week before were analysed for risk of injury using the relative risk calculation recommended in the case-crossover method. Controlling for personal characteristics, there was a 2.8 (95% CI: 1.99–3.96) times greater risk of having an injury if alcohol had been consumed.

Further analyses using an ordinal logistic regression model were conducted to examine if there were differences in the risk of injury associated with different quantities of alcohol consumed. The results found that there was a cumulative risk of having an injury of 1.14 for every 30 ml or two cans of beer (OR = 1.14, 95% CI: 1.003–1.300). Applying this cumulative risk result to the median amount of alcohol reported as consumed by alcohol-related injury participants (ie, 103 ml absolute alcohol), suggests that half of the alcohol-related participants were 3.91 times or more at risk of having an injury than their non alcohol-related injury counterparts. This risk is greater for those participants in the upper quartile percent, with 246 ml of absolute alcohol resulting in a 9.34 times greater risk of injury.

Violence involved in injury occurrence Twenty eight injury cases (17%; males 23, females 5) responded that violence was involved in their injury. The age range of these participants was 16 to 59, median 25.5 years. Of those, 23 (82%) reported that “in their opinion” the other person involved was intoxicated/drunken. In addition, 22 (78%) reported that they had themselves been drinking. With respect to the alleged perpetrator, nearly half (43%) reported that the person involved was unknown to them, while 25% reported that the person was known. The remaining 25% reported a mix of security, police or other authority figures.

Public place was the most commonly reported location for an injury involving violence (39%), followed by licensed outlet (25%), and the home (21%). This is
different to non violence-related injury cases, for which home was reported as the location by 33% and public place by 24%.

**Discussion**

This was the first New Zealand study undertaken to examine the relationship between alcohol and injury among ED attendees. Thirty five per cent of injury cases were found to be alcohol-related. This is higher than that reported in international studies where between 10% and 18% of injury cases have been found to be alcohol-related.10,17 Although seasonality has been found to affect consumption levels18 and these data were collected in December 2000, no significant differences were found between the three data sources of self-reported alcohol consumption (injury occasion, one week before and typical occasion). This result suggests that the injury event was not affected by an assumed increase in alcohol consumption associated with the Christmas season and the millennium celebrations.

It is, however, also likely that these figures could underestimate alcohol involvement; the study used a six-hour exclusion criterion, and so did not include people who had been injured more than six hours previously and who reported, in the screening process, that alcohol was involved at the time of the injury. Few studies have sampled cases for injuries occurring more than six hours previously and as such alcohol-related injuries may be greater than currently identified. An Australian study that did investigate this issue reported that 44% of participants with an injury that occurred between 6 and 24 hours prior to attending the ED, reported consuming alcohol prior to their injury occurring; this is twice the amount who attended the ED within the six-hour period (22%).14 A pilot study undertaken in Canada reported similar results (alcohol-related injury: 24 hours 28.4%, 6 hours 18.2%).19 These studies highlight the potential for under-estimation of alcohol-related injury cases when using a six-hour exclusion period.

This study found that two thirds of all the injuries presented were in males and the under 30 years age group. This result is consistent with international studies.20 The high representation of males is supported by other New Zealand alcohol consumption statistics, which highlight males under 30 as heavy drinkers.21 In addition, their attendance is also in keeping with reports of gender differences in health service usage, in particular ED utilisation.22

One third of all injury cases (alcohol-related or not) reported alcohol consumption patterns reflective of typical heavy drinking patterns. The frequency and quantity of typical occasion drinking patterns appears to be predictive for sustaining an injury. Caution is recommended in interpreting this result further, as the sample size was small, but the connection between heavy and frequent typical drinking and alcohol harms has been found in other studies. For example, Roche et al found that irrespective of alcohol involvement in current injury event, a substantial proportion of all injury cases surveyed were heavy typical drinkers.23

The location where the injury was sustained was found to be moderately predictive of alcohol-related injury. Where drinking location and injury location were the same, home (own or others) and licensed outlet were the most commonly reported locations. When drinking and injury location were not the same, public place and vehicle were
the likely injury locations, possibly indicating a risk of travelling from one drinking location to another (drinking or not) location.

Public place was the most frequently reported location for injury involving violence to occur with – not surprisingly – licensed outlet the second most frequently reported. Although the sample for reported injury involving violence is small, other research has shown that young males in particular do most of their drinking in licensed outlets, and that these places are associated with alcohol involved injury, assault and homicide. Studies with larger samples would allow more detailed investigation of violence and other contextual factors in order to gain a better understanding of how they contribute to the risk of an injury, and who is most at risk. From this broader contextual understanding, policy and prevention strategies would be better informed.

The risk of injury associated with alcohol consumption is well documented. The present results highlight that, when all contextual factors are held constant, there was a 2.8 times greater risk of experiencing an injury when alcohol was involved. This is in line with other non case-crossover studies. For example, a review of accidental falls and alcohol literature by Higson and Howland reported odds ratios (OR) of between 2.5 and 10 for having an alcohol-related injury compared with a non alcohol-related injury. Cheropitel et al reported an OR of 3.53 if the injury case reported feeling drunk at time of injury, and an OR 1.34 when cases reported consuming alcohol but not feeling drunk. However, there is a paucity of research that quantifies the influence of the quantity of alcohol consumed on the risk of an injury event. A study similar to this by Vinson et al reports a similar cumulative risk of injury with increasing amounts of alcohol consumed, as does one by McLeod et al. The findings from this study are consistent with those results and show that cases in the top 25%, who consumed 246 ml absolute alcohol (sixteen cans of beer), were at a nine times greater risk of injury.

This study had all the advantages of the case-crossover design in that assessment of the causal role of alcohol was without socio-demographic confounding. However, information recall is problematic, in particular among participants who were alcohol-related injury cases and whose recall may have been in part impaired due to the alcohol consumed. Study protocol provisions to reduce this were present, that is, delaying the interviewer-led questionnaire to a more appropriate time. Also, provision was made within the questionnaire to capture a range of information on, for example, alcohol consumption, and this contributed to the quality of the data on the use of alcohol immediately before the injury, a similar exposure period (one week before) and typical consumption. Furthermore, the results from this study are consistent with other cited studies and suggest that the findings are not influenced by information recall.

In summary, this is the first study carried out in New Zealand to assess and quantify alcohol involvement in injured patients presenting to an ED. It showed a significantly increased risk of injury when alcohol had been consumed. Furthermore, this risk was increased as the quantity of alcohol consumed increased. The proportion of 35% of the injury presentation as alcohol-related is high by international standards.

The fact that males and the under 30 years age group were the most represented in the alcohol-related injury data and that they are the least likely to utilise health care services other than the ED, suggests that the ED can play an important role in
identifying and investigating contextual factors that influence alcohol-related injuries. It also raises the question of the ED as a potential intervention location. These findings support a growing body of international research highlighting the ED as an environment in which to explore harm minimisation and brief intervention strategies.30–32

**Author information:** Gayl Humphrey, Researcher; Sally Casswell, Director; Dug Yeo Han, Statistician; Alcohol and Public Health Research Unit, University of Auckland

**Acknowledgements:** This project was made possible through funding by the Alcohol Advisory Council of New Zealand to the Alcohol and Public Health Research Unit of the University of Auckland. It is also part of a WHO-sponsored international study. We thank Dr Peter Jones and staff at the Auckland Hospital Emergency Department for their considerable role in this project and the Police at the Auckland Traffic Alcohol Group who loaned the breathalyser machines.

**Correspondence:** Professor Sally Casswell, Centre for Social and Health Outcomes Research and Evaluation (SHORE) Massey University, P O Box 6137, Auckland. Fax: (09) 366 5149; email: s.casswell@massey.ac.nz

**References:**


