

Alcohol and travel in the New Zealand Household Travel Survey

Jennifer McSaveney, Lynley Povey

Research and Statistics, Ministry of Transport¹, New Zealand

Email for correspondence: j.mcsaveney@transport.govt.nz

Abstract

The New Zealand Household Travel Survey is an ongoing survey of household travel conducted by the Ministry of Transport. Each year, people in over 4 000 households throughout New Zealand are invited to participate in the survey by recording all their travel over a two-day period. Each person in the household is then interviewed about their travel, and is also asked about their alcohol consumption up to and over the travel days, and other travel-related information. This survey is important in that the follow-up interviewing occurs within a short time period after the travel and drinking in question, so that it is still fresh in the mind of the interviewee.

This paper focuses on travel before and after alcohol consumption for survey data from 2003 – 2009, and compares it to data from other New Zealand surveys looking at alcohol and travel. After drinking alcohol, travel mode patterns change, with a greater proportion of people being passengers rather than drivers.

1. Introduction

Alcohol consumption in New Zealand is a major area of interest to many people. Previous national surveys on alcohol use occurred in 1995 (Wyllie et al., 1996), 2000 (Habgood et al., 2001), 2004 (Ministry of Health, 2007) and 2007/2008 (Ministry of Health, 2009), with the Alcohol Advisory Council (ALAC) publishing annual drinking behaviour reports for 2005/2006, 2006/2007 and 2007/2009 (Palmer et al., 2007a, 2007b, 2009). Previous New Zealand Travel Surveys in 1989/1990 and 1997/1998 also surveyed alcohol consumption in association with the travel days they surveyed, using methods similar to the current New Zealand Household Travel Survey.

The New Zealand Household Travel Survey (NZHTS) is a survey of household travel conducted for the Ministry of Transport which started in 2003. Currently 4,600 households throughout New Zealand are asked to participate each year but, prior to 2008, 2,200 households were asked to participate. Household members and those staying in the household at the time are asked to record all their travel over a consecutive two-day period. Each person in the household is then interviewed about their travel, and is also asked about their alcohol consumption and for various travel-related information.

Following from McSaveney (2009), which introduced the alcohol consumption data available from the NZHTS, this paper focuses on travel before and after alcohol consumption and compares it to data from other New Zealand surveys looking at alcohol and travel. After drinking alcohol, travel mode patterns change, with a greater proportion of people being passengers rather than drivers.

¹ The opinions expressed in this paper are those of the authors and do not necessarily represent the views of the Ministry of Transport.

2. Methods

The NZHTS is specifically designed to collect data throughout the year at a national and, on a longer timescale, regional level, so that information can be scaled up to represent a year's travel by all New Zealanders. To reduce the effect of under-reporting through forgetfulness, interviews take place as soon as possible after the assigned travel days and within a week of the days being surveyed. On the initial visit, participants are given memory jogger cards for their travel and asked to fill them out. This serves as a memory aid during the detailed questioning by the interviewer. The target population has no age restrictions but is restricted to those living in private residential dwellings. The alcohol consumption portion of the survey is restricted to those aged 15 years and over, and travel results reported in this paper have been restricted to those 15 years and over to match these. Results are weighted to account for age, gender and non-response. More information on the survey methods and weighting is available at: www.transport.govt.nz/research/TravelSurvey/.

The survey uses a face-to-face interview, with results recorded either directly into a laptop or on to paper forms which are transferred on to a computer later. The data collection is contracted out to a third party. The analysis is done in-house by the Ministry of Transport.

For the alcohol consumption component of the survey, participants are asked if they drank any alcohol on the night before the travel days and on the two travel days. If they did drink, they are asked over what time periods they drank and where they drank. The participants are then prompted, using cue cards, to report what they drank and how much. Drinking sessions are defined to be location specific so that, if the participant changed location and continued drinking, a new drinking session is recorded.

There is evidence of significant under-reporting of alcohol consumed on the second travel day, relative to the first travel day and the evening before the first travel day. McSaveney (2009) presented estimates based on the first twenty-four hour period: from 6pm on the day before the first travel day, to 5.59 pm on the first travel day. However, for the purposes of this work, to maximise sample sizes of travel around alcohol consumption, the sessions from both travel days have been used. This may lead to an underestimate of the amount of travel after drinking, or the amount of alcohol in the blood when travelling. Unlike the two previous travel surveys done in New Zealand (1989/90 and 1997/98), where the alcohol consumption question was only asked of respondents who drove during the survey period, the current survey includes alcohol consumption information from all respondents aged 15 and over, whether they drove or not.

The amount of alcohol consumed has been calculated by assigning standard volumes and alcohol contents by percentage to the different drink sizes and types shown on the cue cards. The number of standard drinks is calculated using an assumed mean alcohol content by drink type, with the definition of 10 grams of alcohol per standard drink. A table of the alcohol contents used is available upon request.

Once the amount of alcohol consumed was calculated, it was assumed that this was consumed evenly over the course of the session. A metabolism rate of one standard drink per hour (0.0174 g per decL per hour) was assumed, which is in line with metabolism rates of 0.017 for an "average drinker", 0.02 for a heavy drinker and 0.012 for a below-average alcohol metaboliser. This metabolism rate was then applied to obtain the alcohol remaining in the system at the start of each trip (using the formula of National Highway Traffic Safety Administration (1994), cited in Carey and Hustad (2002)). Females with more than 55g of alcohol in their system were assumed to have a BAC level of over 80 mg/100 ml. If they had more than 35g of alcohol in their system, they were assumed to have a BAC level of over 50 mg/100 ml. Males with more than 70g of alcohol in their system were assumed to have a BAC level of over 80 mg/100 ml. If they had more than 50g of alcohol in their system, they were assumed to have a BAC level of over 50 mg/100 ml.

If more than one session was recorded, this information was used to estimate the residual BAC at the start of the next session. Otherwise BAC was assumed to be zero at the start of a session.

Where calculated, confidence intervals have been stated in the text or in tables in the form X (Lower confidence interval, Upper confidence interval). Variances for travel survey based estimates were estimated using the random groups replication method as described in Wolter (2003). Essentially, the sample was divided randomly into five subsamples, each mirroring the sampling design used for the main sample. An estimate of the parameter of interest (the mean or proportion) was constructed for each group and the variance among these groups was computed. This process was replicated ten times for each parameter of interest and the median variance among the ten iterations was used.

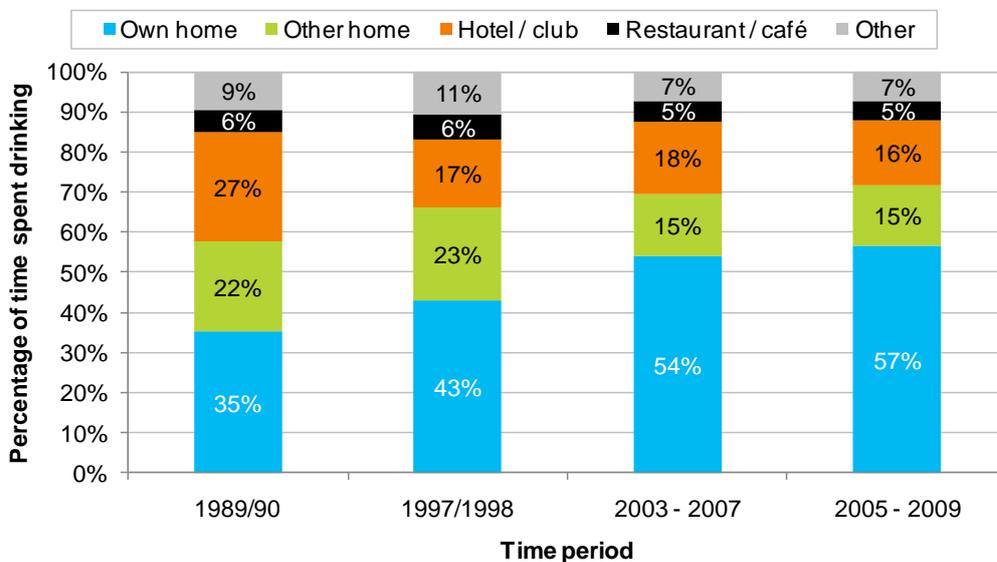
More information on the methods used, including reporting issues associated with the alcohol questions such as reductions in accuracy due to people not being able to remember exact types and quantities when large amounts of alcohol are consumed, is discussed in McSaveney (2009).

3. Travel before drinking

3.1. Drinking venues

As seen from Figure 1, the locations where people report drinking have changed over the past 20 years. Consumption has shifted from 42% of time spent drinking being on licensed premises or ‘other’ (including sports events, outdoors, at work or any other venues not in the other specified categories), to over 70% of the time spent drinking being on private property – a person’s own home or someone else’s home. Drinking at home has become much more common, with 35% of time drinking being at home in 1989/90, rising to 43% in 1997/1998. By 2005 – 2009 this had risen to well over half of all time spent drinking. Further historical comparisons between the surveys for trends are not possible as 1989/90 only surveyed people who drove on the travel days and only collected venue and drinking durations. 1997/98 asked about what people drank, but only surveyed on alcohol for people who reported driving on the survey days.

Figure 1: Percentage of time spent drinking by venue for 1989/1990, 1997/1998, 2003 – 2007 and 2005 – 2009, for drivers



3.2. Travel to drinking venues

Table 1 shows the distribution of the time between the start of a drinking session and the most recent trip leg prior to it. Here we distinguish between sessions where people are drinking at their homes and away from their homes.

Drinking sessions at home are not clustered around the time immediately after getting home, with less than a quarter starting in the first half hour following arrival – 78% of the drinking sessions start within four hours of people finishing their travel.

Conversely 53% of drinking sessions away from home begin within half an hour of finishing the previous trip leg. 87% of drinking sessions away from home occur within 4 hours of the preceding trip.

Table 1: Last travel trip before drinking session (2003 – 2009)

	Prior to home drinking session		Prior to non-home drinking session	
<i>Sample trips</i>	5 706		3 605	
Time between last trip leg and drinking session	Million trip legs per year	% of trip legs	Million trip legs per year	% of trip legs
0 – 29 min	41 (39,43)	24% (21%,27%)	61.4 (58.2,64.6)	53% (48%,58%)
30 min – 59 min	25.6 (24.4,26.8)	15.2% (12.7%,17.6%)	14 (13,15)	12% (9%,15%)
1 hour – 1 hour 59 min	32.3 (30.9,33.7)	19.1% (15.6%,22.5%)	12 (11,13)	10.4% (8.0%,12.9%)
2 hours – 3 hours 59 min	33.9 (32.5,35.4)	20% (17%,23%)	13 (12,14)	11% (8%,14%)
4 hours – 5 hours 59 min	16 (15,17)	10% (7%,12%)	6.6 (6.0,7.3)	5.7% (3.2%,8.2%)
6 hours – 11 hours 59 min	16 (15,17)	10% (7%,12%)	7 (6,8)	6% (3%,9%)
12 hours +	4.3 (3.9,4.6)	2.5% (1.6%,3.4%)	1.7 (1.3,2.1)	1.4% (0.3%,2.6%)

In the subsequent travel analysis, only trip legs in the four hours prior to drinking have been considered associated with the drinking session as ‘pre-alcohol’ trip legs.

Table 2: Mode distribution of the last trip leg in the 4 hours prior to drinking (2003 – 2009)

	All trip legs surveyed	Last trip leg before home drinking sessions	Last trip leg before non-home drinking sessions
<i>Sample</i>	167 863	5 145	3 167
Driver	65% (62%,68%)	73% (69%,77%)	49.4% (43.9%,54.9%)
Passenger	14.5% (13.0%,16.0%)	13.5% (11.1%,16.0%)	29.1% (24.7%,33.6%)
Pedestrian	16% (13%,19%)	11% (7%,15%)	16% (10%,22%)
Public Transport	1.6% (1.1%,2.2%)	0.2% (0%,0.3%)	0.8% (0%,1.6%)
Cyclist	1.0% (0.5%,1.5%)	1.3% (0.2%,2.3%)	0.8% (0.1%,1.4%)
Taxi passenger	0.6% (0.4%,0.8%)	0.1% (0%,0.2%)	2.6% (1%,4.2%)
Other household travel	0.7% (0.2%,1.2%)	0.4% (0%,0.8%)	1.2% (0%,2.4%)

For the purposes of this work, travel modes have been grouped so that motorcycle riders are included with light 4-wheel vehicle drivers (private vehicle driver), and motorcycle pillion passengers have been included with light 4-wheel vehicle passengers (private vehicle

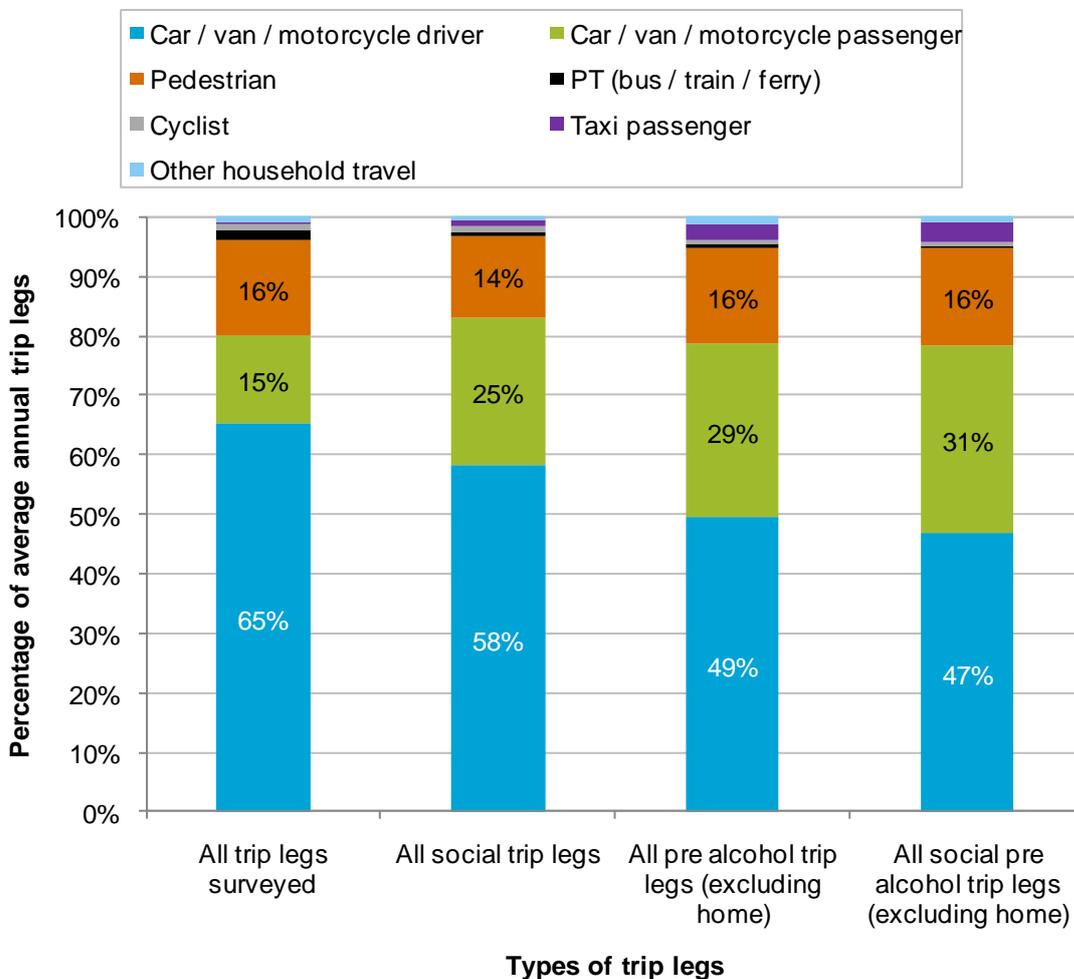
passenger). Public transport (PT) includes bus and train trip legs of 60km or less and ferry trip legs of 1 hour or less. Travel has also been restricted to that by those 15 years and over.

As can be seen from **Error! Reference source not found.**, modal distribution patterns before a drinking session are quite different, depending on whether the drinking session is at the respondent's home or away from their home. Both of these differ from the overall mode distribution. Trip legs home prior to a home drinking session are more likely to involve driving (73% driving trip legs) than average trip legs (65% driving trip legs). Half of the trip legs prior to a non-home drinking session are driven (49%). In contrast, private passenger trips legs form a greater proportion (29%) of trips prior to non-home drinking sessions compared to all trip legs (15%) and trip legs home prior to drinking (14%).

Excluding trip legs home, 70% of trip legs in the four hours prior to a drinking session were social, 16% recreational and 7% personal business (including shopping).

In order to see if the change in mode distribution was to do with the purpose of previous travel (e.g. travelling home or heading out to socialise), overall mode shares for each purpose when generally travelled were examined. Travel for which the main reason was to return home showed a similar distribution to the distribution for all trip legs surveyed (63% driving, 15% private passenger), so is not shown here.

Figure 2: Travel-before-drinking mode share, focusing on comparison to social trip legs (2003 – 2009)



Looking at trip legs for social activities (Figure 2), social trip legs have a lower proportion of driver trips (58% (56%, 61%)) and higher proportion of private passenger trip legs (25%

(23%, 27%) than overall trip legs (65% (62%, 68%) and 15% (13%, 16%) respectively). The mode share distribution of the last trip leg in the four hours prior to a drinking session is also skewed towards private passenger trip legs (29% (25%, 34%)), with half the trip legs (49% (44%, 55%)) being as a driver. This indicates that the travel mode choice may be influenced by the alcohol consumption as well as the trip being for social reasons.

4. Travel after drinking

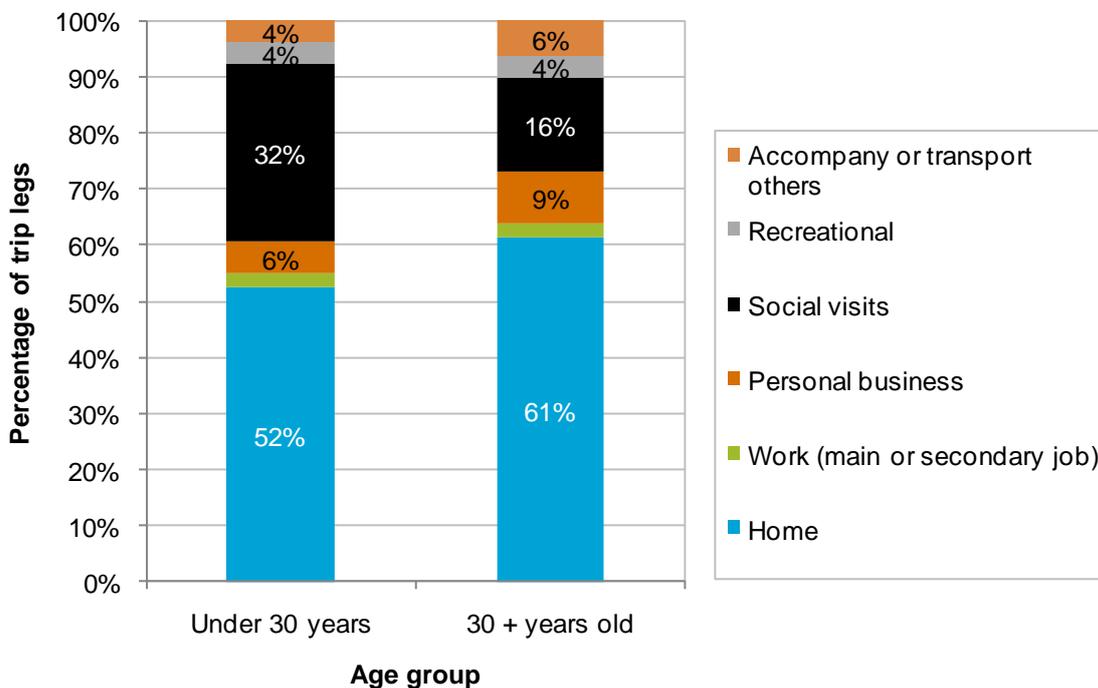
Travel after a drinking session can be examined in two ways: based on the next travel trip leg after the drinking session, or by looking at the BAC level of the person travelling based on the time of travel and amount of alcohol consumed. Both methods have been examined and are discussed below; however, when the patterns of results are similar, the non-zero BAC pattern has been displayed in preference to make the comparison with the higher BAC patterns easier.

4.1. Distribution of first trip leg after end of drinking session

In order to decide which travel trips immediately after a drinking session were of relevance, the time between the end of the drinking session and the next trip leg was examined. 34% of the first trip legs afterwards started less than four hours after the drinking session ended. 65% were 6 or more hours after the drinking session ended.

Looking at the time between drinking and travel as a function of the trip purpose, it was clear that the travel in the immediate four hours after the drinking session ended was more likely to be connected with the previous activity. In the four hours following the drinking session, the first trip leg afterwards was generally for the purpose of travelling home (58.8% (54.4%, 63.1%)), followed by social visiting (20.5% (16%, 25%)). If the first trip after drinking was more than four hours after the drinking session ended, the trip purpose was more mixed, with 28.8% (25.4%, 32.1%) being for personal business (e.g. shopping) and 30.4% (27.3%, 33.4%) for work. Only 12.5% (10%, 15%) of trip legs were for social reasons and only 5.4% (3.8%, 7.0%) were heading home.

Figure 3: Purpose of first trip leg in the four hours following a drinking session, by age (2003 – 2009)

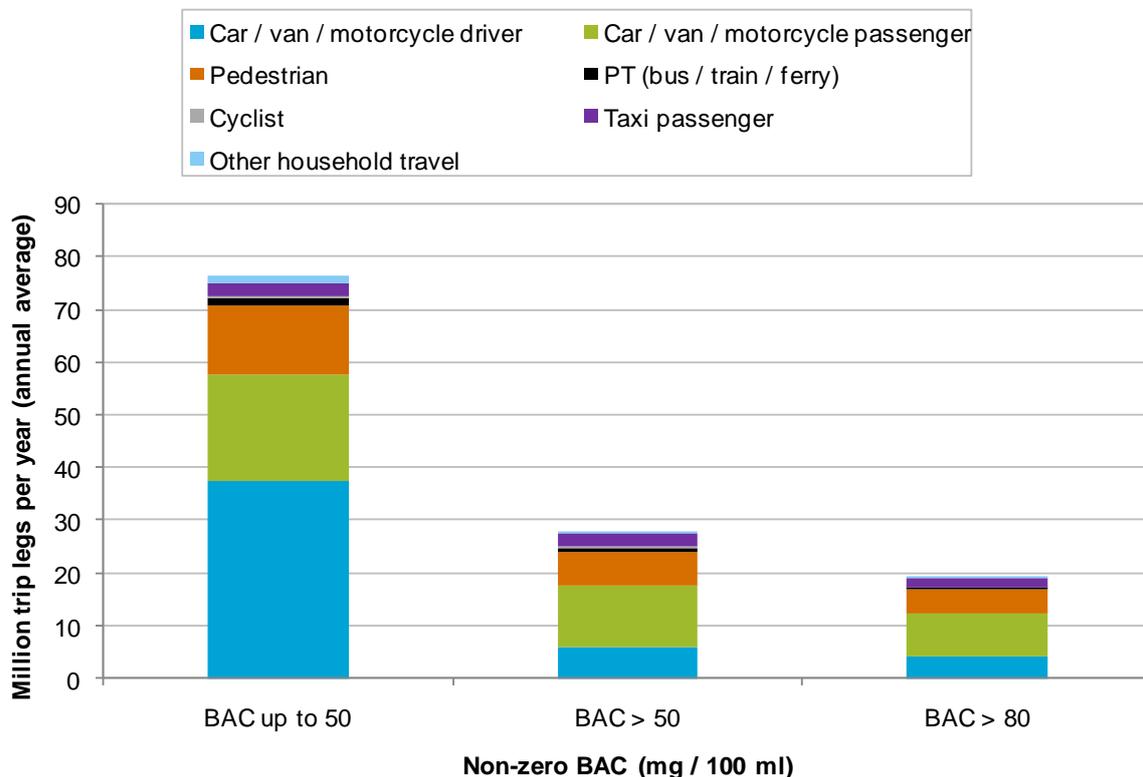


If we examine the trip purpose by age group (Figure 3), a greater proportion of trips after drinking by younger people were for social visits (32% (22%, 42%)), than for people 30 years and over (16% (11%, 22%)). For all ages, more than half the trip legs were to travel home (those for under 30 year olds are not significantly lower (52% (42%, 63%) of trip legs) than those for people 30 years and over (61% (55%, 68%) of trip legs)).

4.2. Travel with a blood alcohol concentration level greater than zero

People aged 15 years and over make about 5 200 (5100, 5300) million trip legs per year in household travel via all modes. Of these, approximately 104 (97, 111) million trip legs per year were started with an estimate non-zero BAC (two percent of all household travel). For nearly 28 (26, 30) million trip legs per year, the person has an estimated BAC of over 50 mg of alcohol per 100 ml of blood (0.5% of all household travel). For 19 (17, 21) million trip legs per year, the person had an estimated BAC of over 80 mg of alcohol per 100 ml of blood (0.4% of all household travel). This is shown in Figure 4 for all travel with a non-zero calculated BAC level.

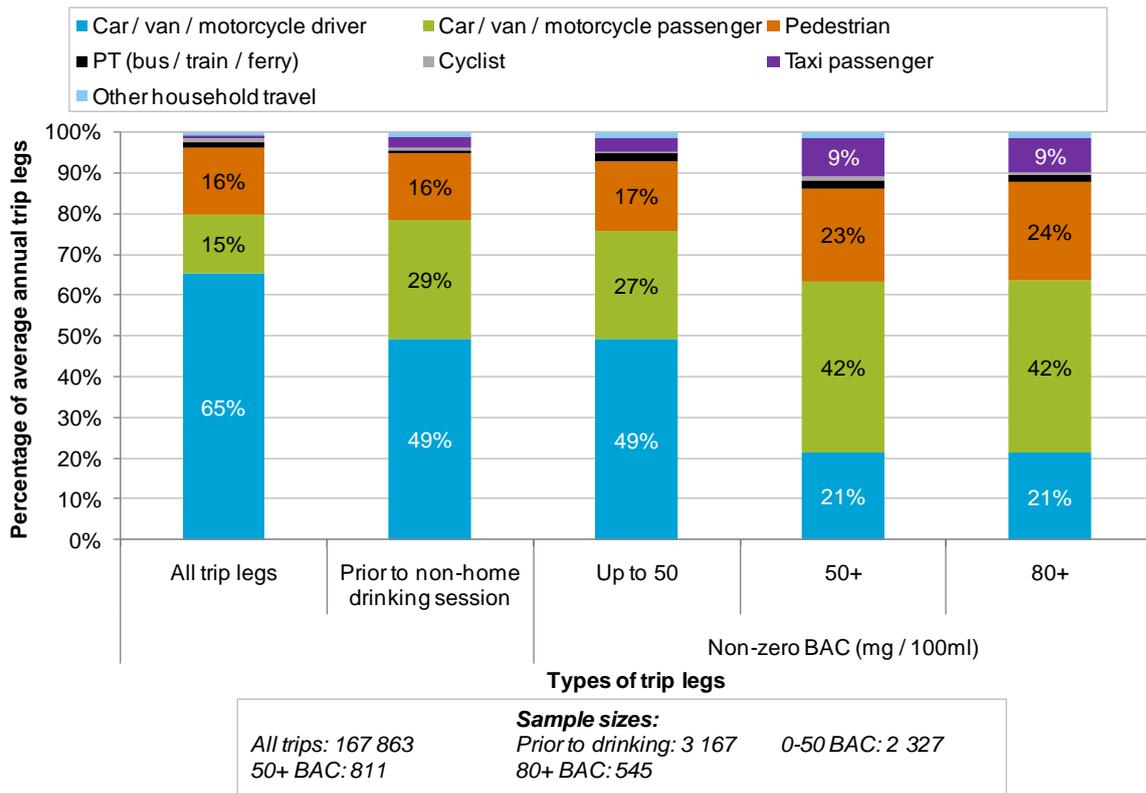
Figure 4: Travel commenced with non-zero BAC level, by mode (2003 – 2009)



4.3. Travel before and after drinking

By examining the travel before drinking sessions and the travel with non-zero BAC, we can get an overall picture of the changing pattern of mode choice depending on alcohol consumption (Figure 5, Table 3).

Figure 5: Mode share before and after drinking sessions (2003 – 2009)



From the trip legs before drinking, we already knew that people were less likely to be driving to their non-home drinking venue (49% (44%, 55%) of trip legs). Examining trips made when the person has a calculated BAC of up to 50 mg/100 ml, the mode choices are very similar to those prior to drinking, indicating no particular change in mode choice after low-level drinking or sufficiently long after drinking². However, there is a marked modal shift when at higher BAC levels. Mode choices when at BAC levels of over 50 and over 80 have been examined to look at the current New Zealand legal adult limit (80) and Australian adult limit (50). Sample sizes were too small to be able to separate out trips made under the current youth alcohol limit (30 mg/100 ml) for those aged 15-19 years old.

From the results shown, a far smaller proportion of trip legs are made as a driver, for those by people with an estimated BAC of over 50 (21% (12%, 30%)) than those of less than 50 (49% (43%, 55%) or more). For people with a BAC of 50 or over, the main travel mode shifts to being a private vehicle passenger (42% (30%, 54%)). Taxi trip legs also start becoming a much larger proportion of travel for those with a BAC greater than 50, making up 9% (4%, 14%) of their trip legs compared to 2.6% (1.0%, 4.2%) of trip legs prior to drinking away from home, and less than a percent (0.6% (0.4%, 0.8%)) of all trip legs.

For those with an estimated BAC of over 80 (over the New Zealand adult limit for driving), the modal distribution is almost identical to that of those with a BAC of over 50. The largest proportion of trip legs are done as private passengers (42% (26%, 36%)), followed by pedestrians (24% (15%, 36%)), with 21% (12%, 31%) of trip legs illegally (by our estimate) travelled as a driver, and 8% (2%, 14%) being taxi passenger trips.

² Time between end of drinking session and travel is an area with the potential for further research within the limitations of the data available.

Table 3: Mode share before and after drinking sessions (2003 – 2009)

	All trips	Prior to non-home drinking session	Non-zero BAC up to 50	BAC>50	BAC>80
Sample size	167 863	3 167	2 327	811	545
Car/van/motorcycle driver	65% (62%,68%)	49% (44%,55%)	49% (43%,55%)	21% (12%,30%)	21% (12%,31%)
Car/van/motorcycle passenger	15% (13%,16%)	29% (25%,34%)	26% (20%,33%)	42% (30%,54%)	42% (27%,57%)
Pedestrian	16% (13%,19%)	16% (10%,22%)	17% (10%,25%)	22% (11%,34%)	24% (11%,36%)
Public transport	1.6% (1.1%,2.2%)	0.8% (0%,1.6%)	1.8% (0.2%,3.5%)	2.0% (0%,4.5%)	2% (0%,5%)
Cyclist	1.0% (0.5%,1.5%)	0.8% (0.1%,1.4%)	0.5% (0%,1.1%)	1%*	1%*
Taxi passenger	0.6% (0.4%,0.8%)	2.6% (1%,4.2%)	3.3% (1.5%,5.2%)	9% (4%,14%)	8% (2%,15%)
Other household travel	0.7% (0.2%,1.2%)	1.2% (0%,2.4%)	1.5% (0.3%,2.8%)	2% (0%,7%)	2%*

* Percentages indicative only as sample sizes too small to calculate confidence intervals by the method used.

4.3.1. Other areas of research

The presented results are a small selection of the results available from the NZHTS on this subject. Travel patterns before and after drinking can also be investigated by age and gender and for urban/rural residential area, but current results are indicative only given the available sample sizes. Preliminary examination by gender indicates that compared to males, females are less likely to drive overall or prior to drinking. However, there is little difference in mode proportions between genders once intoxicated, with both males and females driving in similar proportions (17-24% of trip legs with BAC > 50). Other demographic details such as personal income, household size and type, and NZ deprivation index are available for potential investigation, subject to the relevant sample sizes.

A wide array of future research is possible with the NZHTS data, both with the data currently available and from future data as the sample size grows. Potential areas of future research with currently available data include examining how soon after a drinking session ends that people travel, and how this correlates with alcohol consumption in that session and the travel mode used. There is potential to link travel before and after drinking to investigate if

people travel by a different mode after drinking and how this may relate to the quantity of alcohol consumed.

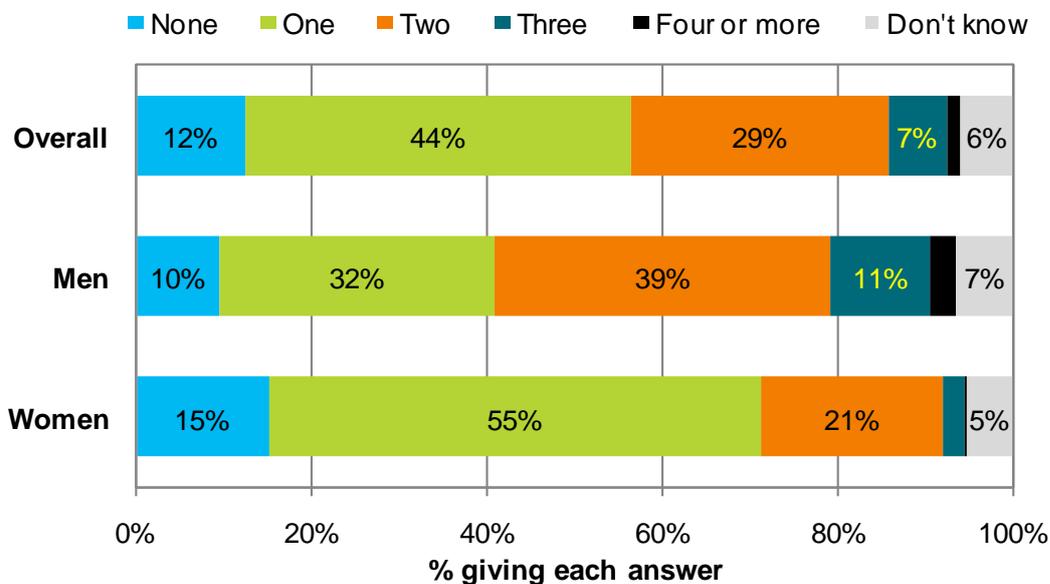
5. Attitudes to travel after drinking and other surveys

While it is useful to see what the practice is in travel after drinking, as evidenced by the Household Travel Survey, other data are available on people's attitudes and self-reported habits after drinking.

The New Zealand Ministry of Transport also conducts an annual survey into attitudes towards road safety (Ministry of Transport, 2009)³. This is a face-to-face survey of 1,600 people aged 15 and over, focussing on attitudes towards alcohol, speed and restraint use, as well as road safety in general. Of particular interest is a new question introduced in 2009 on how much alcohol people thought someone of the same gender as them should be allowed to consume in an hour, if that person was going to be driving immediately afterwards (Figure 6).

Figure 6: Drinking before driving (Ministry of Transport, 2009)

How many standard drinks should a man/ a woman be allowed to have in an hour if planning to drive immediately afterwards?*



**Men were asked about men and women were asked about women.*

Overall, 86% (84%, 88%) thought that the limit should be two or fewer drinks in an hour; 80% (77%, 83%) of men thought men should be limited to two drinks or fewer; 91% (89%, 93%) of women thought women should be limited to two drinks or fewer. It should be noted that two standard drinks in an hour will put women at a higher BAC level than the equivalent number of drinks in the average male. These survey results indicate that most of the New Zealanders surveyed thought people should be limited to a number of drinks more closely related to the Australian 50 mg/100 ml BAC limit than the current New Zealand adult limit of 80 mg/100 ml BAC.

³ www.transport.govt.nz/research/Pages/2009publicattitudestoroadsafetysurvey.aspx (accessed 23.5.2010).

5.1. Self-reported drink driving

The attitudes survey also asks people to report if they have driven while slightly intoxicated in the past year. In Ministry of Transport (2009), 21% (1%, 24%) of drivers reported having done so. This is a high proportion of drivers, however it is still much lower than the proportion who reported doing so in 1995 (30% (27%, 33%)). There are strong gender differences. In 1995, 41% (37.5%, 44.5%) of males reported driving while feeling slightly intoxicated. This has improved to 29% (26%, 32%) of male drivers surveyed in 2009. Only 15% (13%, 17%) of female drivers report having driven while slightly intoxicated. By age, a greater percentage of younger drivers report having driven while feeling slightly intoxicated: about a quarter of drivers under 60, but 11% (9%, 13%) of those over 60, reported driving while intoxicated. It should be noted that 'slightly intoxicated' was not defined, so may mean different things to different people and may also have changed over time.

Other surveys have examined self-reported driving under the influence. Ministry of Health (2009) surveyed alcohol and drug use in New Zealand in 2007/2008 for over 6,500 New Zealanders aged 16-64, and found similar reported levels of driving while under the influence of alcohol. They reported that approximately 20% of the people surveyed who had drunk alcohol in the past year had driven a car or other motor vehicle (including a boat) while under the influence of alcohol. This was approximately 17% of the adult population aged 16-64 years old. They found similar trends with age and gender, with men being more likely to report having driven while under the influence (27% of those who drank in the past year), and younger people being more likely to have done so than older people.

Examining the Household Travel Survey data from a population perspective, approximately ten percent of the population aged 15 years and over reported travelling by any mode with a BAC level greater than zero during the two surveyed travel days; two percent had done so with a BAC >50 and approximately one and a half percent had done so with a BAC of over 80. Focussing on driving, the fractions are much smaller, as less than five percent of those aged 15 years and over reported driving with a BAC >0; 0.6% reported having driven with a BAC of over 50; with only 0.4% having driven with a BAC of over 80. This is much lower than the self-reporting rates for the Public attitudes survey (Ministry of Transport, 2009) and the Ministry of Health survey (2009), but this is not surprising due to the difference in sampling an activity for two days of a person's behaviour, as compared to whether or not they have done that activity at some point in the past 12 months.

6. Conclusion

Analysis of alcohol consumption and travel data from the New Zealand Household Travel Survey indicates that travel mode patterns shift for those travelling when intoxicated, when compared to normal travel, with a higher proportion of the trip legs being made as passengers rather than driving a car, van or motorcycle. Travel prior to drinking away from home shows a similar trend, indicating that the travel mode patterns are changed prior to heading out to drink, rather than afterwards, and that the mode choices made afterwards are further changed depending on how much has been drunk and/or how long it is after the person has stopped drinking. Potential areas for further research into trends by age, gender and residential area have also been identified.

Self-reported drink driving and attitudes to drinking and driving have been examined from a variety of sources, and trends indicate that progress has been made with a smaller proportion of people reporting driving while under the influence of alcohol. This is reflected in the mode choices made after drinking, but there is still room for improvement to reduce the fatal effect of alcohol on people using New Zealand roads.

References

- Carey K and Hustad J, 2002. *Are Retrospectively Reconstructed Blood Alcohol Concentrations Accurate? Preliminary Results from a Field Study*. *Journal of Studies on Alcohol*. 63(6), pp. 762- 766
- Habgood R, Casswell S, Pledger M, Bhatta K, 2001. *Drinking in New Zealand: National surveys comparison 1995 and 2000*. Auckland: Alcohol and Public Health Research Unit.
- McSaveney J, 2009. *Alcohol consumption in the Ongoing New Zealand Household Travel Survey*, Australasian Transport Research Forum, Auckland, 29 September – 2 October.
- Ministry of Health, 2007. *Alcohol Use in New Zealand: analysis of the 2004 New Zealand Health Behaviours Survey: Alcohol Use*. Wellington: Ministry of Health.
- Ministry of Health, 2009. *Alcohol Use in New Zealand: analysis of the 2007/08 New Zealand Alcohol and Drugs Survey*. Wellington: Ministry of Health.
- Ministry of Transport, 2009. *Public attitudes to road safety: results of the 2009 survey*. Wellington: Ministry of Transport.
(<http://www.transport.govt.nz/research/Pages/2009publicattitudestoroadsafetysurvey.aspx> accessed 23 May 2010)
- National Highway Traffic Safety Administration, 1994. *Computing a BAC Estimate* Washington: Department of Transportation
- Palmer S, Fryer M, Kalafatelis E, 2007a. *ALAC Alcohol Monitor Adult and Youth 2005-06 Annual Report*. Research New Zealand for Alcohol Advisory Council.
- Palmer S, Fryer M, Kalafatelis E, 2007b. *ALAC Alcohol Monitor Adult and Youth 2006-07 Annual Report*. Research New Zealand for Alcohol Advisory Council.
- Palmer S, Fryer M, Kalafatelis E, 2009. *ALAC Alcohol Monitor Adult and Youth 2007-08 Annual Report*. Research New Zealand for Alcohol Advisory Council.
- Wolter K, 2003. *Introduction to Variance Estimation*. Springer Series in Statistics. New York.
- Wyllie A, Millard M, Zhang J, 1996. *Drinking in New Zealand: A national survey 1995*. Auckland: Alcohol and Public Health Research Unit.