centre for alcohol policy research

Foundation for Alcohol Research & Education

Measuring risky drinking:

An examination of the validity of different episodic drinking thresholds in predicting alcohol-related harms

Dr Michael Livingston

August 2013

About the Centre for Alcohol Policy Research

The Foundation for Alcohol Research and Education (FARE) provides core funding to the Centre for Alcohol Policy Research (CAPR), a world-class alcohol policy research institute. Led by Professor Robin Room, the Centre examines alcohol-related harms and the effectiveness of alcohol-related policies. CAPR is a joint undertaking of the Victorian Government, the University of Melbourne, Turning Point Alcohol and Drug Centre and FARE. It operates as one of Turning Point's research programs, with core funding from FARE.

CAPR not only contributes to policy discussions in Australia but also contributes to international studies of significance for the World Health Organization. An example of its international work is the *GENACIS project*, which examines gender alcohol and culture internationally.

The Centre has also undertaken a pioneering study, The *Range and Magnitude of Alcohol's Harm to Others*, that is the cost of alcohol-related harms on people other than the drinker, otherwise referred to as third party harms. Results from the study were also included in the World Health Organization's *Global Status Report on Alcohol and Health 2011*, and WHO is using the study as a model for such studies globally.

About the Foundation for Alcohol Research and Education

FARE is an independent charitable organisation working to prevent the harmful use of alcohol in Australia. Our mission is to help Australia change the way it drinks by:

- helping communities to prevent and reduce alcohol-related harms;
- building the case for alcohol policy reform; and
- engaging Australians in conversations about our drinking culture.

Over the last 11 years FARE has have invested more than $115 million, helped 800 organisations and funded over 1,500 projects addressing the harms caused by alcohol misuse.

FARE is guided by the World Health Organization's *Global Strategy to Reduce the Harmful Use of Alcohol* for addressing alcohol-related harms through population-based strategies, problem-directed policies, and direct interventions.

If you would like to contribute to FARE's important work, call us on (02) 6122 8600 or email fare@fare.org.au. All donations to FARE over $2 are tax deductible.

Contents

Summary

In 2009 the National Health and Medical Research Council released revised low-risk drinking guidelines, which suggested that Australians drinking five or more standard drinks on a particular occasion were putting themselves at risk of harm (1). These guidelines were heavily criticised (2, 3), despite being broadly consistent with guidelines specified internationally. In the research literature too, studies of episodic drinking typically use a measure based on the frequency of drinking five or more standard drinks (a definition which itself varies based on the standard units being used). While this threshold clearly defines drinking behaviour with a range of risks and negative consequences, there has been limited research outside of United States college-based studies to determine its appropriateness.

This report explores this issue in two ways. Firstly, using the 2010 National Drug Strategy Household Survey data, a variety of different drinking thresholds are examined, to determine the demographic and attitudinal predictors of episodic heavy drinking at various levels (i.e. 5+, 11+ and 20+ drinks). There are significant variations in prevalence rates depending on the threshold used:

- 42% of drinkers report drinking 5+ drinks on a monthly basis
- 15.8% of drinkers report drinking 11+ drinks on a monthly basis and
- 5% of drinkers report drinking 20+ drinks on a monthly basis.

There are substantial variations in heavy drinking prevalence based on demographic and other factors. Generally speaking, across all three definitions, heavy episodic drinking is more common amongst males, young adults, people who have never married, those living in regional Australia, people who smoke, people who use illicit drugs, people who started drinking at younger ages and people who drink beer or pre-mixed spirits.

Across the three different definitions of risky drinking, broadly similar relationships were identified, suggesting that the same factors are associated with heavy drinking regardless of how it is defined.

The second phase of this study examined 15 risky-drinking thresholds (based on volume and frequency) and their relationship with three self-reported alcohol-related problems and behaviours to try to determine the most appropriate definition of 'risky-drinking'. The most appropriate risky drinking threshold identified varied depending on the mode of analysis (i.e. on the goodness of fit measure used) and on the type of outcome being considered (e.g. thresholds were generally higher for injury than for self-reported risky behaviour). In general, risky drinking thresholds of seven or fewer drinks provided the best balance between sensitivity (ability of a threshold to correctly identify people likely to experience harm) and specificity (the ability of a threshold to correctly identify people not likely to experience harm). These findings support the continuing use of a risky-drinking definition of five or more drinks, based on the Australian drinking guidelines.

Introduction

Alcohol consumption contributes to a substantial public health burden in Australia, with the most recent estimates available attributing 3.2% of the burden of disease to risky drinking (4). Given this burden, there is significant research interest in examining the characteristics, behaviours and negative consequences experienced by people who drink at 'risky' levels. Typically, the definition of 'risky drinking' in Australian research has been based on the Australian Guidelines to Reduce Health Risks from Drinking Alcohol ('the Alcohol Guidelines') produced by the National Health and Medical Research Council (NHMRC), which specify thresholds for both episodic consumption and longer-term drinking. In other words, the Alcohol Guidelines conceptualise risky drinking of two types, based on drinking patterns and total volume of consumption. There is increasing evidence that drinking pattern (i.e., risky episodes of drinking) is a key driver of negative health and social consequences from alcohol consumption (5-7). Similarly, the focus of much media and policy attention in the alcohol field is on 'binge' or episodic heavy drinking (8, 9).

Given this focus, developing a robust definition of episodic risky drinking is a key requirement. Under the Alcohol Guidelines, short-term risky drinking is defined as an episode of drinking where five or more standard drinks[1] are consumed. This threshold was derived from meta-analyses of data from emergency department studies examining the role of alcohol consumption in injury morbidity and mortality. The authors of the Alcohol Guidelines picked an absolute risk threshold of one in 100, which was met by drinkers who consumed five or more drinks twice-weekly. While there was some evidence that mortality risk increased more rapidly above the 5+ threshold, the use of the one in 100 risk level was arbitrary, and based on acceptable risks in other settings (1). This definition is widely used in alcohol research in Australia to define 'risky drinkers' (10). There has been some criticism of this threshold as being overly inclusive. For example, using this threshold, 45% of Australians aged 18 and over are classified as short-term risky drinkers (10). Further, this threshold does not capture extremely heavy drinking, which may be increasing in Australia. For example, a recent Victorian study found that more than 40% of 16-24 year olds reported drinking episodes of more than 20 standard drinks, up from 26% in 2002 (11).

In United States (US) studies of risky drinking, a threshold equivalent to six or seven Australian standard drinks (five US drinks) is more widely used (e.g. 12, 13). Again, this threshold has been criticised as being too low, particularly for college populations (14). In response to these criticisms, a series of studies have been undertaken to assess the validity of the US threshold. Using survey data, both Wechsler et al. and Weitzman et al. find no evidence that a higher threshold for defining episodic risky drinking is more valid, with increases in the threshold resulting in more accurate prediction of harm rates amongst the 'risky drinking' group, but also higher rates of false negatives (i.e. non-risky drinkers who report harm) (15, 16). Framing their results in terms of the prevention paradox, Weitzman et al. argue that the use of a lower risky-drinking threshold is the most likely approach to reduce alcohol-related harms as, while prevalence of harm is higher among the heaviest

[1] Note that an Australian standard drink is 10g of alcohol, while US standard drinks are between 12 and 14g.

drinking young people, the number of lower-level drinkers is so much higher that they account for the majority of harms experienced (16). Other studies have broadly supported the use of risky-drinking thresholds at or below seven Australian drinks. Using event-based data, Jackson et al. found little evidence that higher thresholds were better at predicting the experience of harm (17), while Dawson et al., examined a range of potential drinking guidelines, finding that a risky-drinking threshold of four US drinks (approximately six Australian standard drinks) performed the best at predicting a range of negative outcomes (18).

Thus, there is a reasonable evidence base from US studies of college populations that using episodic risky drinking thresholds higher than five to seven drinks provides little additional benefit in predicting alcohol-related harms. However, there has been little attempt to validate these findings either on broader populations (i.e. non-college samples) or in a non-US context. Thus, this study uses Australian survey data to examine the predictive utility of different definitions of short-term risky drinking on a range of alcohol-related harms.

Methods

Data

This study uses data from the 2010 National Drug Strategy Household Survey (NDSHS). The NDSHS is a national survey of the Australian population aged 12 and over. The data were collected using a drop and collect approach, with data collected from a final sample of 26,648 respondents (based on a participation rate of 50.6%). The survey collects a wide range of data on alcohol, tobacco and other drug use, along with items on consequences of and attitudes to alcohol and drug use, health-related items and a suite of socio-demographic measures. Full details of the methods, the questionnaire and the broad findings of the NDSHS are available in the main survey report (10).

The analyses presented here were based only on respondents who had consumed at least one alcoholic drink in the last 12 months and who had provided complete answers to the detailed graduated frequency items relating to alcohol consumption at varying levels. This led to the exclusion of 5,099 (19.1%) respondents who had not consumed alcohol in the last 12 months and 1,752 respondents (6.7%) who provided insufficiently detailed or inconsistent consumption data, leaving a final sample of 19,757 (74.1% of the original sample). All analyses are based on weighted data for this group of respondents.

The initial aim of this study was to examine how demographic and other factors were associated with heavy episodic drinking across a range of definitions. In other words, are the factors that are significantly associated with drinking 5+ drinks the same as those that are associated with drinking 20+ drinks. Simple descriptive analyses were undertaken to examine this issue, with the prevalence of regular (at least 12 times per year) risky drinking across three definitions (5+, 11+ and 20+) examined. The demographic variables examined were: age, sex, household income, family situation, neighbourhood socio-economic status, remoteness, smoking status, illicit drug use, age at first drink and preferred beverage type.

The secondary aim of this study was to compare the utility of a range of different threshold measures for episodic risky drinking. Thus, a series of thresholds were set based on frequency and quantities of consumption, with the lowest threshold set at the consumption of three drinks on an occasion at least once in the last 12 months and the highest threshold set at weekly or more frequent drinking occasions of 20 or more standard drinks. The complete set of risky-drinking thresholds examined is presented in Table 1.

Table 1 - Risky drinking thresholds used in part two of this study

Quantity	Frequency (last 12 months)		
3 or more standard drinks	1+ occasions	12+ occasions	52+ occasions
5 or more standard drinks	1+ occasions	12+ occasions	52+ occasions
7 or more standard drinks	1+ occasions	12+ occasions	52+ occasions
11 or more standard drinks	1+ occasions	12+ occasions	52+ occasions
20 or more standard drinks	1+ occasions	12+ occasions	52+ occasions

These thresholds will be presented in the rest of this paper as 'quantity/frequency'. For example, the threshold based on drinking seven or more drinks on 12 or more occasions will be presented as' 7+/monthly', while five or more on 52 or more occasions will be presented as 5+/weekly. Using each of these thresholds, respondents were classified as either risky-drinkers or non-risky drinkers based on their answers to the graduated quantity-frequency questions (17) in the NDSHS. Thus, for example, a respondent who reported 15 drinking occasions in the last year and consumed six drinks on each of these occasions would be classified as a risky-drinker using the 3+/yearly, 3+/monthly, 5+/yearly and 5+/monthly thresholds, but as a non-risky-drinker using all the other thresholds. These 15 thresholds were tested by examining how useful they were for predicting the experience of alcohol-related harm. Three different measures of harm were used.

The first measure of harm was based on a single item, "Have you, or someone else, been injured because of your drinking?" with respondents whose drinking had resulted in an injury in the last 12 months coded as 'Yes' and respondents who reported no injuries or injuries more than 12 months ago coded as 'No'. The 205 respondents who refused to answer this question were excluded from the analyses based on the question. The remaining harm measures were based on a 10-item scale, focusing on behaviours and consequences related to alcohol in the 12 months prior to the survey. Previous analyses have demonstrated that these items cluster into two groups, described as hazardous behaviours and delinquent behaviours (20). The 10 items and their classification into the two broad groups are presented in Table 2. Respondents were classified as having engaged in hazardous behaviours if they had engaged in any of the five relevant items. Similarly, any positive response to the delinquent behaviour question meant that a respondent was classified as having engaged in delinquent behaviour. In other words these two measures only capture whether or not respondents engaged in these behaviours not how often or how many different types they engaged in.

Table 2 - Classification of survey items into broad harm indicators

Specific survey item	Broad harm group
Went to work under the influence of alcohol	Hazardous behaviour
Went swimming under the influence of alcohol	
Operated a boat under the influence of alcohol	
Drove a motor vehicle under the influence of alcohol	
Operated hazardous machinery under the influence of alcohol	
Created a public disturbance or nuisance while under the influence of alcohol	Delinquent behaviour
Caused damage to property while under the influence of alcohol	
Stole money, goods or property while under the influence of alcohol	
Verbally abused someone while under the influence of alcohol	
Physically abused someone while under the influence of alcohol	

Analysis

For the initial, descriptive stage of the study, simple survey prevalence tables were run, with differences in prevalence between demographic categories considered significant if confidence intervals did not overlap. Following these descriptive analyses, logistic regression models were produced to examine the key demographic predictors of heavy drinking using each of the three definitions.

For the second section of the study, two stages of analyses were undertaken. Firstly, simple descriptive tables were run to calculate the risk functions of each of the three harms being examined across each of the thresholds. These risk functions were then plotted to provide a rudimentary means of assessing whether any particular threshold represented a key point beyond which risk increased rapidly. These simple descriptive tables were also used to calculate straightforward sensitivity and specificity values for each of the three harms (across all thresholds). The sensitivity of each threshold is defined as the proportion of respondents who experienced each outcome who were classified as 'risky-drinkers' based on each threshold (true positives). The specificity of each threshold is defined as the proportion of respondents who did not experience each harm and who were not classified as 'risky-drinkers' by the threshold (true negatives).

In the second stage of analyses, logistic regression models were developed to determine the predictive utility of each of the 15 thresholds being examined. Separate models were run for each threshold and harm with age, sex and marital status included as control variables. Three goodness-of-fit measures were calculated for each of these 15 models: the Bayesian Information Criteria (BIC), the McFadden pseudo R-squared and the Pearson Chi-Squared. The BIC is a model selection metric based on the likelihood function and is lower for a better-fitting model (21). The McFadden pseudo R-squared for logistic regression is a rough measure of the proportion of variation in the data

explained by the model, and is higher for a better-fitting model (22). Finally, the Pearson Chi-Squared statistic is based on the sum of the difference between observed and expected outcome and is lower for a better performing model (23). Values of each of these measures were compared across the fifteen models to assess which threshold values performed best in predicting each type of harm.

Results

Demographic predictors of heavy episodic drinking

The prevalence of monthly heavy drinking using three different definitions (5+, 11+ and 20+) is presented for a range of demographic and other variables in Table 3 (overleaf). For the sake of clarity, these descriptive analyses just focus on three threshold values based on monthly frequencies. The patterns of association are generally similar across the three different definitions of heavy drinking. In these simple analyses across all three measures of risky drinking the following relationships were observed:

- Men were more likely to report risky drinking than women
- Young adults (18-29) were more likely than older adults (30+) or teenagers (14-17) to report risky drinking
- Respondents who had never been married were more likely to drink riskily than married, divorced or widowed respondents
- Respondents in remote areas were more likely to drink riskily than those in regional or metropolitan areas
- Other risky behaviours (e.g. illicit drug use, smoking and early initiation of drinking) were associated with higher rates of risky drinking
- Respondents whose main drink was regular (i.e. full-strength) beer were the most likely to report risky drinking, with wine-drinkers the least likely.

While these patterns were consistent across all three thresholds, in general the higher thresholds produced starker differences. For example, men are more likely than women to report episodic heavy drinking episodes across all three categories but the gender differences widen as the threshold used increases – men are 1.7 times more likely than women to report monthly 5+ occasions, and 3.3 times more likely to report monthly 20+ occasions. Similarly respondents aged 18-19 were 3.9 times more likely than those aged 60+ to report monthly 5+ drinking, but 10.9 times more likely to report monthly 20+ drinking.

Table 3 - Prevalence of monthly risky drinking based on three different definitions, by demographic and other factors

	n	% monthly 5+	% monthly 11+	% monthly 20+
Gender				
Male	10,112	53.0% (51.8% - 54.2%)	22.4% (21.3% - 23.4%)	8.2% (7.5% - 8.9%)
Female	9,112	30.8% (29.7% - 31.8%)	8.6% (7.9% - 9.3%)	2.5% (2.1% - 2.9%)
Age				
14-17 years	731	47.5% (42.3% - 52.6%)	17.0% (13.3% - 20.6%)	4.4% (2.5% - 6.2%)
18-19 years	716	68.4% (63.5% - 73.2%)	35.2% (30.3% - 40.3%)	15.3% (11.5% - 19.2%)
20-29 years	3,682	63.7% (61.5% - 65.8%)	29.5% (27.5% - 31.5%)	11.5% (10.0% - 12.9%)
30-39 years	3,528	49.8% (48.0% - 51.6%)	19.7% (18.2% - 21.2%)	6.0% (5.0% - 6.9%)
40-49 years	3,538	41.7% (39.8% - 43.6%)	13.2% (11.9% - 14.5%)	3.8% (3.0% - 4.5%)
50-59 years	3,007	33.4% (31.5% - 35.2%)	8.4% (7.3% - 9.5%)	2.7% (2.1% - 3.4%)
60+ years	3,872	17.6% (16.4% - 18.7%)	3.4% (2.9% - 4.0%)	1.4% (1.0% - 1.8%)
Household income				
<$13k	528	33.1% (28.7% - 37.5%)	13.7% (10.7% - 16.7%)	6.9% (4.8% - 9.1%)
$13k - < $31.2k	1,496	28.4% (26.0% - 30.8%)	10.2% (8.5% - 12.0%)	5.1% (3.7% - 6.5%)
$31.2k - <$52k	2,119	37.3% (34.9% - 39.6%)	12.4% (10.8% - 14.1%)	3.9% (2.9% - 4.8%)
$52k - <$83.2k	3,107	43.9% (42.0% - 45.9%)	16.4% (14.8% - 17.9%)	5.3% (4.4% - 6.3%)
$83.2k - <$145.6k	4,535	49.2% (47.4% - 50.9%)	17.5% (16.1% - 18.9%)	5.2% (4.3% - 6.0%)
$145.6k+	2,463	51.6% (49.1% - 54.0%)	20.0% (18.0% - 22.1%)	6.2% (4.9% - 7.5%)
Not answered	4,874	38.0% (36.3% - 39.8%)	15.2% (13.8% - 16.5%)	6.2% (5.2% - 7.1%)
Marital status				
Never Married	4,660	60.3% (58.4% - 62.2%)	28.3% (26.5% - 30.1%)	11.6% (10.3% - 12.9%)
Widowed	581	12.4% (10.0% - 14.9%)	3.1% (1.9% - 4.2%)	1.3% (0.5% - 2.0%)
Divorced/separated	1,349	38.8% (36.2% - 41.3%)	14.1% (12.2% - 16.1%)	6.2% (4.8% - 7.5%)
Married/defacto	11,911	37.3% (36.3% - 38.3%)	11.5% (10.8% - 12.1%)	2.9% (2.6% - 3.3%)
Family situation				
No dependent kids	10,475	40.5% (39.5% - 41.6%)	15.5% (14.6% - 16.3%)	5.9% (5.3% - 6.5%)
Dependent kids	6,455	42.4% (41.0% - 43.8%)	14.4% (13.4% - 15.5%)	3.8% (3.2% - 4.3%)
Socio-economic status of neighbourhood				
SEIFA quintile 1 (most disadvantaged)	3,125	42.3% (40.2% - 44.5%)	17.0% (15.3% - 18.7%)	7.4% (6.2% - 8.6%)
SEIFA quintile 2	3,422	44.8% (42.8% - 46.7%)	17.9% (16.3% - 19.5%)	6.4% (5.4% - 7.4%)
SEIFA quintile 3	3,875	42.4% (40.5% - 44.2%)	16.4% (14.9% - 17.9%)	4.9% (4.0% - 5.9%)
SEIFA quintile 4	4,299	42.0% (40.2% - 43.7%)	15.3% (14.0% - 16.6%)	4.9% (4.1% - 5.7%)
SEIFA quintile 5 (least disadvantaged)	4,401	41.1% (39.4% - 42.8%)	13.3% (12.0% - 14.6%)	4.5% (3.7% - 5.3%)

	n	% monthly 5+	% monthly 11+	% monthly 20+
Remoteness				
Major cities	12,937	40.9% (39.9% - 41.9%)	14.6% (13.8% - 15.4%)	4.9% (4.4% - 5.4%)
Inner regional	3,987	44.4% (42.6% - 46.2%)	16.8% (15.4% - 18.3%)	5.5% (4.6% - 6.3%)
Outer regional/remote	2,198	47.8% (45.4% - 50.2%)	20.9% (18.9% - 23.0%)	8.7% (7.2% - 10.1%)
Illicit drug use				
Never used any illicit drugs	9,871	27.4% (26.3% - 28.5%)	7.6% (6.9% - 8.2%)	2.4% (2.0% - 2.9%)
Used cannabis but no other illicits	4,442	53.9% (52.2% - 55.7%)	18.4% (17.0% - 19.8%)	4.7% (3.9% - 5.4%)
Used illicits other than cannabis	4,520	64.4% (62.8% - 66.0%)	31.3% (29.6% - 33.0%)	12.7% (11.5% - 14.0%)
Smoking status				
Daily smoker	3,208	59.1% (57.1% - 61.1%)	28.0% (26.1% - 29.8%)	12.4% (11.0% - 13.8%)
Occasional smoker	684	70.1% (66.0% - 74.3%)	36.5% (32.1% - 41.0%)	12.2% (9.3% - 15.1%)
Ex smoker	5,293	42.1% (40.7% - 43.6%)	12.9% (11.8% - 14.0%)	3.4% (2.8% - 4.0%)
Non smoker	9,928	35.2% (34.1% - 36.4%)	12.0% (11.1% - 12.8%)	3.9% (3.4% - 4.4%)
Age at first drink				
First drink aged <13	1,210	62.9% (59.6% - 66.3%)	34.6% (31.2% - 38.1%)	14.2% (11.7% - 16.7%)
13-14	2,593	63.5% (61.2% - 65.7%)	29.7% (27.5% - 32.0%)	11.2% (9.6% - 12.8%)
15	2,569	58.7% (56.4% - 61.0%)	24.0% (21.9% - 26.1%)	8.2% (6.8% - 9.6%)
16	3,746	49.6% (47.7% - 51.5%)	16.1% (14.7% - 17.6%)	4.6% (3.8% - 5.4%)
17	2,608	40.5% (38.3% - 42.7%)	10.5% (9.0% - 11.9%)	3.0% (2.2% - 3.8%)
18	3,347	25.1% (23.4% - 26.8%)	6.3% (5.2% - 7.3%)	1.8% (1.3% - 2.4%)
Older than 18	2,908	13.6% (12.2% - 15.0%)	3.8% (2.9% - 4.6%)	1.9% (1.2% - 2.5%)
Main drink				
Cask wine	756	28.9% (25.4% - 32.4%)	6.5% (4.5% - 8.6%)	2.1% (0.8% - 3.3%)
Bottle wine	6,047	28.0% (26.8% - 29.3%)	6.5% (5.8% - 7.2%)	1.5% (1.2% - 1.9%)
Regular beer	3,999	68.2% (66.4% - 70.0%)	31.7% (29.9% - 33.6%)	12.8% (11.4% - 14.2%)
Mid/light beer	2,250	40.2% (37.9% - 42.5%)	12.9% (11.2% - 14.5%)	3.3% (2.5% - 4.1%)
Pre-mixed drinks	2,185	48.0% (45.3% - 50.6%)	18.8% (16.6% - 20.9%)	6.7% (5.3% - 8.1%)
Spirits	2,987	42.6% (40.4% - 44.8%)	17.3% (15.6% - 19.0%)	5.5% (4.5% - 6.5%)
Cider	142	45.8% (35.4% - 56.2%)	18.2% (9.9% - 26.6%)	6.0% (0.8% - 11.2%)
Other	141	26.8% (17.9% - 35.8%)	8.1% (1.9% - 14.2%)	4.8% (0.1% - 10.0%)

The two measures of socio-economic status provided interesting exceptions to this general pattern of consistent relationships across the three measures of risky drinking. Respondents with higher household incomes were much more likely to report monthly drinking occasions of five or more drinks (51.6% in the highest income category compared with 33.1% in the lowest), however the income gradient for 20+ drinking was flat, with approximately the same proportions of all income groups reporting this behaviour (the relationship for 11+ drinking was somewhere in between). Similarly, while there were no significant differences in 5+ drinking across neighbourhood quintiles

of disadvantage, respondents living in more disadvantaged neighbourhoods were significantly more likely to report monthly 20+ drinking (7.4% in the most disadvantaged quintile of neighbourhoods compared with 4.5% in the least disadvantaged).

To provide a more comprehensive examination of the variables associated with risky drinking, a series of logistic regression models are presented in Table 4.

Table 4 - Logistic regression models predicting risky drinking (one model for each of three risky-drinking definitions).

Variable	Monthly 5+ drinking		Monthly 11+ drinking		Monthly 20+ drinking	
	Odds Ratio	95% Confidence interval	Odds Ratio	95% Confidence interval	Odds Ratio	95% Confidence interval
Main drink (cask wine as ref)						
Bottle wine	0.60*	(0.50-0.72)	0.67*	(0.49-0.93)	0.69	(0.40-1.21)
Regular beer	1.51*	(1.24-1.83)	1.65*	(1.20-2.26)	1.95*	(1.15-3.30)
Light/mid beer	0.82	(0.67-1.00)	1.01	(0.72-1.40)	1.11	(0.64-1.94)
Pre-mixed spirits	0.63*	(0.51-0.78)	0.95	(0.68-1.34)	1.23	(0.70-2.15)
Spirits	0.67*	(0.55-0.81)	1.01	(0.73-1.41)	1.20	(0.70-2.07)
Cider	0.70	(0.44-1.13)	0.82	(0.42-1.63)	0.61	(0.17-2.22)
Other	0.38*	(0.23-0.63)	0.60	(0.26-1.37)	0.92	(0.25-3.33)
Age at first drink (<13 as ref)						
13-14	1.15	(0.96-1.37)	0.98	(0.81-1.18)	0.86	(0.67-1.12)
15	0.97	(0.81-1.15)	0.73*	(0.60-0.89)	0.61*	(0.47-0.81)
16	0.83*	(0.70-0.98)	0.65*	(0.54-0.78)	0.45*	(0.34-0.60)
17	0.78*	(0.65-0.92)	0.49*	(0.40-0.61)	0.46*	(0.33-0.64)
18	0.46*	(0.39-0.55)	0.35*	(0.28-0.44)	0.27*	(0.19-0.40)
>18	0.36*	(0.29-0.43)	0.36*	(0.27-0.47)	0.50*	(0.34-0.74)
Smoking status (daily smoker as ref)						
Occasional smoker	1.09	(0.88-1.35)	1.04	(0.83-1.30)	0.81	(0.60-1.11)
Ex-smoker	0.65*	(0.59-0.73)	0.54*	(0.47-0.62)	0.42*	(0.34-0.53)
Non-smoker	0.43*	(0.39-0.48)	0.44*	(0.38-0.50)	0.40*	(0.32-0.49)
Illicit drug use (never as ref)						
Cannabis only	1.90*	(1.73-2.08)	1.71*	(1.48-1.97)	1.43*	(1.12-1.82)
Illicits other than cannabis	2.08*	(1.88-2.30)	2.33*	(2.03-2.69)	2.45*	(1.95-3.09)
Remoteness (major city as ref)						
Inner regional	1.26*	(1.14-1.39)	1.32*	(1.15-1.51)	1.27*	(1.02-1.58)
Outer regional/remote	1.27*	(1.14-1.42)	1.40*	(1.21-1.62)	1.75*	(1.41-2.16)
SEIFA Quintile (most disadvantaged as ref)						
2	1.07	(0.95-1.22)	1.10	(0.93-1.29)	0.96	(0.75-1.22)
3	1.01	(0.89-1.14)	1.02	(0.86-1.21)	0.77*	(0.59-0.99)

Variable	Monthly 5+ drinking		Monthly 11+ drinking		Monthly 20+ drinking	
	Odds Ratio	95% Confidence interval	Odds Ratio	95% Confidence interval	Odds Ratio	95% Confidence interval
4	1.02	(0.90-1.16)	0.92	(0.78-1.10)	0.77*	(0.59-0.99)
5 (least disadvantaged)	1.01	(0.89-1.16)	0.84	(0.70-1.02)	0.81	(0.61-1.08)
Family situation						
Dependent children (vs no dependent children)	0.74*	(0.68-0.82)	0.88	(0.77-1.00)	0.86	(0.69-1.05)
Marital status (never married as ref)						
Widowed	0.60*	(0.47-0.77)	0.72	(0.47-1.10)	0.58	(0.30-1.13)
Divorced/separated	0.85*	(0.73-0.99)	0.89	(0.73-1.08)	0.87	(0.65-1.15)
Married/defacto	0.65*	(0.57-0.73)	0.57*	(0.49-0.66)	0.42*	(0.34-0.52)
Household income (<$13,000 as ref)						
$13k - < $31.2k	0.74	(0.59-0.94)*	0.79	(0.59-1.07)	0.79	(0.53-1.19)
$31.2k - <$52k	0.95	(0.75-1.19)	0.55	(0.40-0.77)*	0.57*	(0.37-0.88)
$52k - <$83.2k	1.13	(0.90-1.42)	0.60	(0.44-0.81)*	0.42*	(0.27-0.65)
$83.2k - <$145.6k	1.36	(1.08-1.70)*	0.80	(0.59-1.08)	0.62*	(0.41-0.93)
$145.6k+	1.53	(1.21-1.95)*	0.87	(0.64-1.17)	0.70	(0.47-1.05)
Not answered	0.92	(0.73-1.15)	1.03	(0.75-1.41)	0.81	(0.52-1.26)
Age group (14-17 year olds as ref)						
18-19 years	2.02*	(1.26-3.24)	2.97*	(1.79-4.94)	3.53*	(1.63-7.68)
20-29 years	1.59*	(1.08-2.33)	1.81*	(1.17-2.81)	2.63*	(1.31-5.29)
30-39 years	0.93	(0.63-1.37)	1.18	(0.75-1.84)	1.80	(0.88-3.69)
40-49 years	0.69	(0.47-1.02)	0.78*	(0.50-1.22)	1.28	(0.62-2.64)
50-59 years	0.50*	(0.33-0.74)	0.53*	(0.33-0.85)	1.13	(0.53-2.37)
60+ years	0.34*	(0.22-0.50)	0.35*	(0.21-0.57)	0.80	(0.37-1.74)
Gender						
Females (vs males)	0.43*	(0.39-0.47)	0.35*	(0.31-0.40)	0.40*	(0.33-0.48)
Constant	3.55*	(2.25-5.60)	0.82	(0.44-1.52)	0.20*	(0.08 - 0.53)

* $p < 0.05$

As with the bivariate relationships presented in Table 3, the results of the logistic regressions suggest that similar factors are associated with heavy drinking across all three definitions examined here. Men, young adults and people living in regional and rural areas are more likely to report risky drinking, as are respondents who smoke, use illicit drugs or started drinking alcohol at a young age. Respondents who were never married were the most likely to drink riskily, with widowed respondents the least likely. There were few differences by main beverage type, with regular strength beer drinkers the most likely to report risky drinking.

Again, the effect sizes for income and SEIFA quintile show the most change over the three models. When 5+ drinking is examined, the highest income groups are significantly more likely to be risky drinkers, but at higher threshold levels, the lowest income group is more likely than middle income groups to drink riskily. Similarly, while there are no differences across SEIFA quintiles for 5+ or 11+ drinking, the most advantaged and most disadvantaged neighbourhoods have higher rates of 20+ drinking than the middle quintiles. These findings suggest that there may be some qualitative differences in the relationship between socio-economic status and risky drinking at different levels.

Given the broad findings of similarity in the significant demographic and social correlates identified across the three different thresholds of risky drinking examined here, the remainder of this study will focus on determining whether or not an optimal risky drinking threshold can be derived empirically from the survey data.

Testing the optimal threshold for defining risky drinking

The relationships between risky-drinking threshold and the risk of experiencing each of the three harms are presented in Figures 1-3. Across each harm-type, the risk functions increase steadily as the risky-drinking threshold is raised, and are significantly higher when frequency is increased. There is some indication, particularly for delinquent and hazardous behaviours (Figures 2 and 3) that the increase in risk is not straightforwardly linear, with the increase in risk slowing as the risky-drinking threshold is raised. For a risk curve to provide an obvious threshold the reverse relationship would need to be true – that is, there would need to be an ideal risk threshold above which risk increases more quickly than below. Thus, these exploratory charts do not point to a clearly defined risky-drinking threshold.

Figure 1 - Proportion of risky-drinkers who report that either they or somebody else have been injured in the past 12 months due to their drinking, by risky-drinking threshold (amount and frequency)

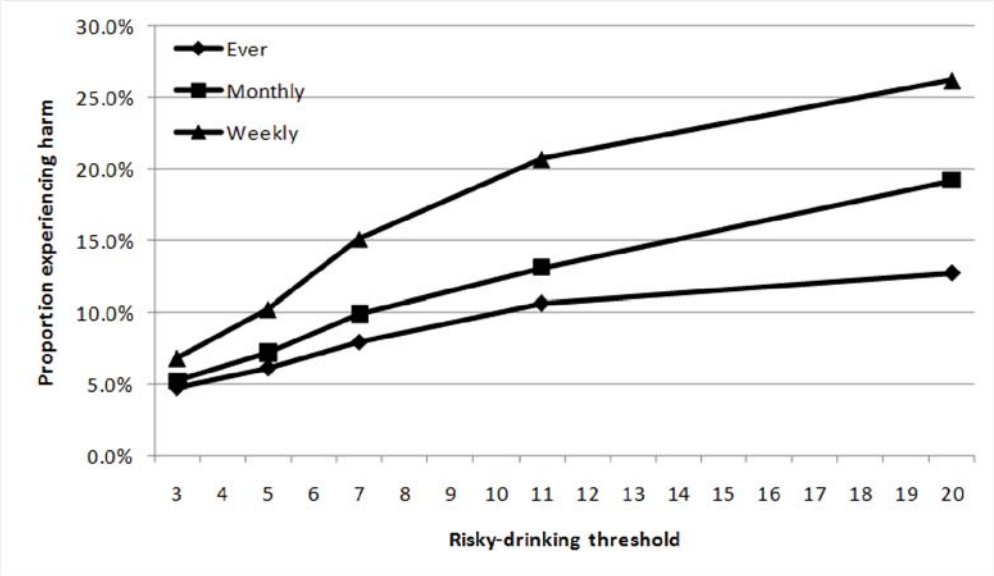


Figure 2 – Proportion of risky-drinkers who report hazardous behaviour in the past 12 months due to their drinking, by risky-drinking threshold (amount and frequency)

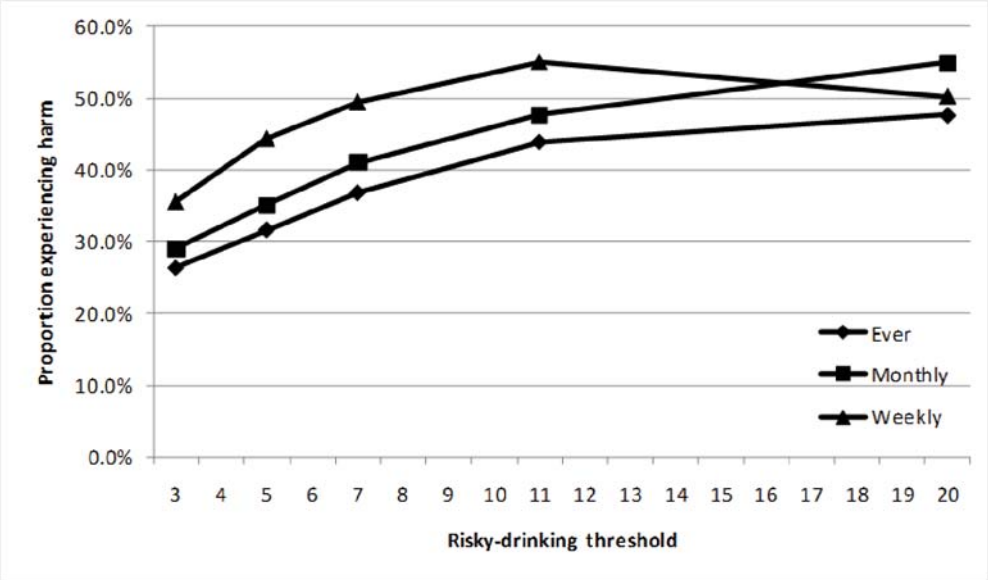
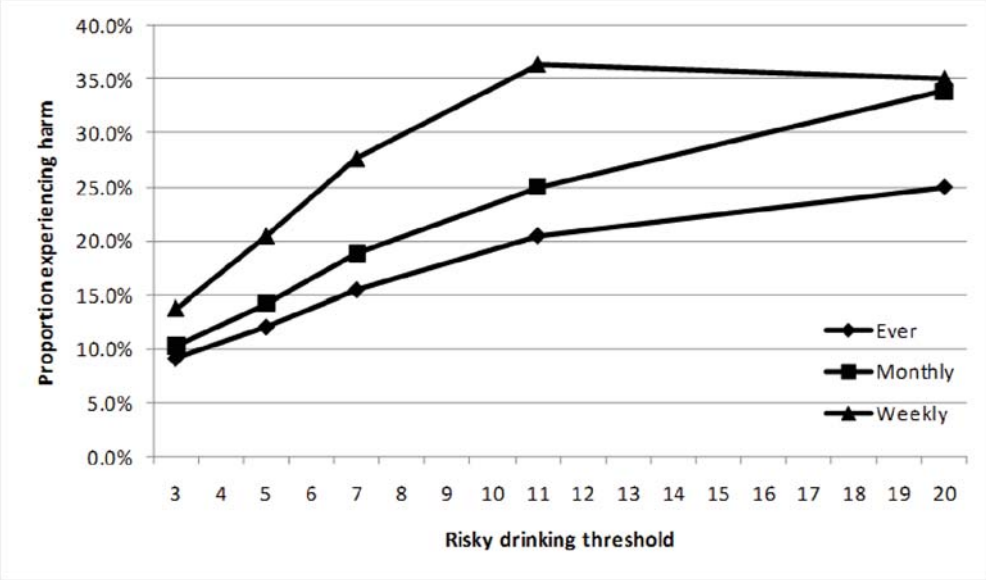


Figure 3 – Proportion of risky-drinkers who report delinquent behaviour in the past 12 months due to their drinking, by risky-drinking threshold (amount and frequency)



The sensitivity and specificity of each of the proposed thresholds are presented in Table 5. The sensitivity of each threshold is defined as the proportion of respondents who experienced each outcome who were classified as 'risky-drinkers' based on each threshold (true positives). The specificity of each threshold is defined as the proportion of respondents who did not experience each harm and who were not classified as 'risky-drinkers' by the threshold (true negatives). An ideal threshold would have 100% sensitivity and 100% specificity – that is, it would perfectly discriminate between drinkers who experience harm and those that do not. To assess which threshold provided

the best balance of sensitivity and specificity, a series of Receiver Operator Characteristic (ROC) curves were developed. These curves provide a means of assessing which threshold performs closest to the theoretical optimal threshold (24). These ROC curves are not reproduced here, but the optimal thresholds for each outcome type derived from this analysis are highlighted in Table 5, below.

Table 5 – Sensitivity and specificity of each risky-drinking threshold for three types of alcohol-related harm, best-fitting thresholds highlighted

Threshold	Injury		Hazardous behaviour		Delinquent behaviour	
	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
3+/yearly	95.1%	34.1%	92.2%	38.6%	97.0%	34.8%
3+/monthly	90.9%	43.3%	88.0%	48.8%	94.9%	44.4%
3+/weekly	70.7%	66.9%	63.6%	72.6%	74.3%	68.5%
5+/yearly	89.0%	53.1%	80.1%	58.9%	92.0%	55.5%
5+/monthly	84.4%	62.6%	**71.6%**	**68.5%**	87.8%	64.3%
5+/weekly	54.9%	83.5%	41.0%	87.8%	57.0%	85.0%
7+/yearly	79.9%	68.0%	64.7%	73.7%	**82.3%**	**69.7%**
7+/monthly	**71.9%**	**77.4%**	51.7%	82.3%	71.7%	79.2%
7+/weekly	38.6%	92.6%	21.3%	94.8%	36.1%	93.6%
11+/yearly	62.2%	82.0%	44.5%	86.5%	62.7%	83.6%
11+/monthly	53.1%	87.9%	33.1%	91.4%	52.5%	89.4%
11+/weekly	21.6%	97.2%	9.5%	98.2%	18.8%	97.8%
20+/yearly	45.2%	89.4%	28.9%	92.4%	45.7%	90.7%
20+/monthly	26.5%	96.2%	12.6%	97.5%	23.5%	96.9%
20+/weekly	11.0%	98.9%	3.2%	99.2%	6.8%	99.2%

This straightforward analysis suggests that the best-performing thresholds vary by harm type. A risky-drinking threshold of seven or more drinks at least 12 times per year performs the best for alcohol-related injuries, while 5+/monthly is the optimal threshold for hazardous behaviour and 7+/yearly for delinquent behaviour. These analyses make no attempt to deal with the variation in drinking patterns and underlying harm rates that occur across sub-groups of the population. Thus, the subsequent analyses use multivariate methods to assess risky drinking thresholds while controlling for age, gender and marital status.[2]

A series of logistic regression models were developed with each of the three alcohol-related harms as the outcome variables and with gender, age and marital status along with the varying risky-drinking thresholds included as predictor variables. The regression outputs are not reproduced here; instead Table 6 presents the goodness-of-fit measures for each of the 45 (3 outcomes x 15 thresholds) models to compare the appropriateness of the risky-drinking thresholds for each outcome. The three measures (described earlier) used were: the BIC (lower = better performing

[2] Note that regression analyses controlling for income, neighbourhood socio-economic status and region along with sex, age and marital status were developed, but made no difference to the best-performing thresholds identified.

model), the pseudo R-squared (higher = better performing model) and the Pearson's Chi-squared (lower = better performing model).

The results of the multivariate analyses have a similar pattern to the more straightforward results presented earlier – thresholds for the injury and delinquent behaviour harms are slightly higher than those for hazardous behaviour. The ideal threshold for the injury outcome in the multivariate models is 7+/monthly for two of the measures and 7+/yearly for the other. The thresholds for hazardous behaviour are much lower – 3+/monthly using two measures and 5+/yearly using the other. Delinquent behaviour is somewhere in between, with a best performing threshold of 5+/monthly using two of the measures and 3+/weekly using the other.

Table 6 – Model fit statistics for logistic regression models testing each risky-drinking threshold across three types of alcohol-related harm, best-fitting thresholds highlighted

Threshold	Injury			Hazardous behaviour			Delinquent behaviour		
	Pseudo R^2	BIC	Chi-Squared	Pseudo R^2	BIC	Chi-Squared	Pseudo R^2	BIC	Chi-Squared
3+/yearly	0.192	4440.4	93.4	0.120	16301.9	122.0	0.180	7278.6	97.1
3+/monthly	0.197	4414.4	81.4	**0.133**	**16061.6**	125.3	0.197	7130.1	103.6
3+/weekly	0.215	4316.6	86.0	0.132	16072.7	132.1	0.215	6977.0	**79.8**
5+/yearly	0.205	4368.7	87.3	0.071	16190.3	**110.8**	0.203	7083.1	100.5
5+/monthly	0.216	4312.6	72.7	0.128	16141.1	114.9	**0.221**	**6922.2**	93.7
5+/weekly	0.220	4289.7	92.1	0.118	16337.1	133.2	0.217	6958.5	101.0
7+/yearly	0.213	4328.7	**71.7**	0.122	16264.5	143.6	0.212	7004.1	172.2
7+/monthly	**0.225**	**4263.3**	74.8	0.116	16360.2	150.7	0.217	6957.6	136.4
7+/weekly	0.216	4310.9	103.8	0.095	16750.6	143.9	0.196	7144.6	105.1
11+/yearly	0.214	4320.4	79.1	0.112	16445.2	158.8	0.205	7065.9	131.6
11+/monthly	0.219	4284.7	78.0	0.104	16589.1	165.4	0.208	7035.9	121.6
11+/weekly	0.199	4402.6	115.4	0.083	16983.1	165.1	0.174	7335.4	136.2
20+/yearly	0.207	4362.7	81.2	0.098	16700.6	180.1	0.194	7161.2	132.2
20+/monthly	0.201	4393.7	118.0	0.085	16931.5	159.8	0.176	7317.0	161.6
20+/weekly	0.191	4460.4	79.3	0.074	17143.5	157.2	0.151	7530.9	139.8

Discussion

In the initial phase of this report, three different risky drinking thresholds are examined (5+, 11+ and 20+ drinks). While the prevalence rates of these behaviours vary substantially (42% of respondents report drinking 5+ drinks on a monthly basis, compared with just 5% who regularly drink 20+ drinks), the associations between them and a range of demographic and behavioural factors do not vary much. This implies that common underlying factors are linked to risky episodic drinking across all three levels and doesn't identify any particular factors related to exceptionally heavy drinking in this sample. The one area where some differences existed was in socio-economic status, with relationships between disadvantage and risky drinking more pronounced for the heaviest definition of risky drinking. This may go some way to explaining the disparity between drinking rates and harm-rates across socio-economic groups, with the most disadvantaged groups generally reporting fewer risky drinking episodes (defined as 5+ or similar) and higher rates of morbidity and mortality (25, 26). This is an area that requires further examination in future research. More generally, the similarities across the three thresholds examined were striking, prompting further analyses attempting to identify optimal risky drinking definitions.

The overall picture provided by both the multivariate and bivariate analyses in this phase of the project is that the best performing risky drinking threshold will vary considerably depending on the outcome of interest. For the most serious outcome examined here (injury), the best performing thresholds were generally higher than those for the less serious outcomes. Even within a single outcome measure, the ideal threshold varied based on the analytical approach used, with differing results between bivariate and multivariate approaches and even within the same multivariate approach, depending on the measure used to assess model fit. Overall, it is clear that risky drinking thresholds set at around five to seven Australian standard drinks (3.5 – 5 U.S. standard drinks) is likely to provide the optimal balance between sensitivity and specificity. While people who drink at higher levels clearly put themselves at greater risk of alcohol-related harms, setting thresholds at 11 or 20 standard drinks results in large numbers of people not classified as risky drinkers who experience harm from alcohol. These findings are broadly similar to the previous studies in the US. These studies, based largely on college student populations, have typically found that a risky drinking threshold of five US drinks (seven Australian drinks) provides the appropriate balance between sensitivity and specificity 15,16).

Given the results of this study, there is no obvious need to move away from using the current NHMRC guidelines (five or more drinks in a session = risky-drinking) to assess risky drinking in the short-term. The use of this threshold has the advantage of being consistent with national health advice and with much of the existing research in the field, and is clearly a reasonable level use based on the findings presented here. However, it's worth noting that the ideal threshold for 'risky drinking' will vary substantially depending on the particular 'risk' you're interested in. As in this

study, where the most serious outcome (injury) was best modelled using a higher threshold, previous studies have found that higher thresholds are more appropriate for more severe outcomes (15, 17).

This study has a number of weaknesses. Other studies have examined whether thresholds vary for males and females (18), while this study has examined risky-drinking thresholds across the entire population (while controlling for age and sex). This was based largely on the use of a single risky drinking guideline for males and females in the current Australian drinking guidelines (1), but future research using Australian data should explore whether ideal cut-points for defining risky drinking vary across sex- and age-based population sub-groups. Further, the specific harms examined here were limited to those that were included in the NDSHS and thus incorporate a fairly narrow range of negative outcomes and behaviours. Future work using a broader range of alcohol-related consequences would provide a better indication of how risky-drinking thresholds vary across types of harm.

The study is also limited by its use of survey data, based on a 50% cooperation rate and covering only 50% of the alcohol actually consumed in Australia. These limitations are common to most studies of these issues and it is worth considering how these findings compare to risky-drinking thresholds based on other methodologies. For example, a meta-analysis of emergency room studies found some evidence of non-linear risk functions, with risk increasing more rapidly above 60g-70g of alcohol (6-7 standard drinks) (27), although these studies are based on drinking immediately prior to the injury and may over-estimate risk levels for methodological reasons (28). The analyses underlying the recent Australian drinking guidelines based on previous modelling (29) attempted to model lifetime risk of injury mortality based on given drinking patterns, and found that non-linear risk functions best fitted the data, with inflection points at around five to eight Australian standard drinks, suggesting that five standard drinks is a reasonable threshold for defining risky drinking (1, p46). However, there is growing evidence that self-reported consumption is unreliable at higher levels of drinking, suggesting inflection points may be artefacts of systematic under- or over-reporting of drinking above five drinks (30, 31).

Thus, the findings of this survey-based study fit broadly with the findings of previous studies using both survey data and objective outcome measures. This suggests that, in spite of the weaknesses identified above, the findings presented here are relatively robust. Thus, in spite of the increased levels of risk experienced by drinkers who engage in extremely heavy drinking episodes, there is no evidence that the use of risky drinking thresholds at these very high levels provides a better means of assessing risky drinking. In other words, the findings of this study support the ongoing use of episodic risky-drinking definitions based on five or more Australian drinks.

References

1. National Health and Medical Research Council (2009) Australian Guidelines to Reduce Health Risks from Drinking Alcohol (Canberra, NHMRC).

2. Bachelard, M. & Gilmore, H. (2008) Three drinks and you're out. The Age, 15/6/2008. http://www.theage.com.au/national/three-drinks-and-youre-out-20080614-2qng.html

3. Campbell, J. (2011) Feel like a drink? Don't tell grog police. Sunday Herald Sun. 4/12/2011. www.heraldsun.com.au/feel-like-a-drink-dont-tell-grog-police/story-fn6bn88w-1226213154237

4. Begg, S., Vos, T., Barker, B. et al. (2007) *The burden of disease and injury in Australia 2003* (Canberra, Australian Institute of Health and Welfare).

5. Bobak, M., Room, R., Pikhart, H. et al. (2004) Contribution of drinking patterns to differences in rates of alcohol related problems between three urban populations, *J Epidemiol Community Health*, 58, 238-242.

6. Gmel, G., Room, R., Kuendig, H. & Kuntsche, S. (2007) Detrimental drinking patterns: Empirical validation of the pattern values score of the Global Burden of Disease 2000 study in 13 countries., *Journal of Substance Use*, 12, 337-358.

7. Rehm, J., Gmel, G., Room, R. & Frick, U. (2001) Average volume of alcohol consumption, drinking patterns and related burden of mortality in young people in established market economies of Europe, *Eur Addict Res*, 7, 148-51.

8. Gartrell, A. & Veness, P. (2008) Rudd to tackle binge drinking 'epidemic' *The Herald Sun* (Melbourne).

9. Stark, J. (2007) Alarm over binge-drinking epidemic *The Age* (Melbourne, Fairfax).

10. AIHW (2011) 2010 National Drug Strategy Household Survey Report. *Drug Statistics Series, No. 25* (Canberra, AIHW).

11. Victorian Drug and Alcohol Prevention Council (2010) 2009 Victorian Youth Alcohol and Drug Survey - Final Report (Melbourne, Victorian Department of Health).

12. Wechsler, H., Moeykens, B., Davenport, A., Castillo, S. & Hansen, J. (1995) The adverse impact of heavy episodic drinkers on other college students, *Journal of Studies on Alcohol*, 56, 628-634.

13. Weitzman, E. R., Folkman, A., Folkman, K. L. & Wechsler, H. (2003) The relationship of alcohol outlet density to heavy and frequent drinking and drinking-related problems among college students at eight universities, *Health & Place*, 9, 1-6.

14. White, A. M., Kraus, C. L. & Swartzwelder, H. S. (2006) Many college freshmen drink at levels far beyond the binge threshold, *Alcoholism: Clinical and Experimental Research*, 30, 1006-1010.

15. Wechsler, H. & Nelson, T. F. (2006) Relationship Between Level of Consumption and Harms in Assessing Drink Cut-Points for Alcohol Research: Commentary on "Many College Freshmen Drink at Levels Far Beyond the Binge Threshold" by White et al, *Alcoholism: Clinical and Experimental Research*, 30, 922-927.

16. Weitzman, E. R. & Nelson, T. F. (2004) College Student Binge Drinking and The" Prevention Paradox": Implications For Prevention And Harm Reduction, *Journal of drug education*, 34, 247-265.

17. Jackson, K. M. (2008) Heavy episodic drinking: Determining the predictive utility of five or more drinks. , *Psychology of Addictive Behaviours*, 22, 68-77.

18. Dawson, D. A., Smith, S. M., Pickering, R. P. & Grant, B. F. (2012) An empirical approach to evaluating the validity of alternative low-risk drinking guidelines, *Drug and Alcohol Review*, 31, 141-150.

19. Gmel, G., Graham, K., Kuendig, H. & Kuntsche, S. (2006) Measuring alcohol consumption-should the 'graduated frequency 'approach become the norm in survey research?, *Addiction*, 101, 16-30.

20. Livingston, M. & Room, R. (2009) Variations by age and sex in alcohol-related problematic behaviour per drinking volume and heavier drinking occasion, *Drug and Alcohol Dependence*, 101, 169-175.

21. Schwarz, G. (1978) Estimating the dimension of a model, *The annals of statistics*, 6, 461-464.

22. Veall, M. R. & Zimmermann, K. F. (1996) Pseudo-R2 Measures For Some Common Limited Dependent Variable Models, *Journal of Economic Surveys*, 10, 241-259.

23. Bluman, A. G. (1992) *Elementary Statistics* (Dubuque, Wm. C. Brown).

24. Beck, J. R. & Shultz, E. K. (1986) The use of relative operating characteristic (ROC) curves in test performance evaluation, *Archives of pathology & laboratory medicine*, 110, 13.

25. Makela, P. & Paljarvi, T. (2008) Do consequences of a given pattern of drinking vary by socioeconomic status? A mortality and hospitalisation follow-up for alcohol-related causes of the Finnish Drinking Habits Surveys, *British Medical Journal*, 62, 728.

26. Najman, J. M., Williams, G. M. & Room, R. (2007) Increasing socioeconomic inequalities in male cirrhosis of the liver mortality: Australia 1981-2002, *Drug Alcohol Rev*, 26, 273-8.

27. Taylor, B., Irving, H. M., Kanteres, F. et al. (2010) The more you drink, the harder you fall: A systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together, *Drug and Alcohol Dependence*, 110, 108-116.

28. Gmel, G. & Daeppen, J. B. (2007) Recall bias for seven-day recall measurement of alcohol consumption among emergency department patients: implications for case-crossover designs, *Journal of Studies on Alcohol and Drugs*, 68, 303-310.

29. Rehm, J., Room, R. & Taylor, B. (2008) Method for moderation: measuring lifetime risk of alcohol-attributable mortality as a basis for drinking guidelines, *Int J Methods Psychiatr Res*, 17, 141-51.

30. Northcote, J. & Livingston, M. (2011) Accuracy of Self-Reported Drinking: Observational Verification of 'Last Occasion' Drink Estimates of Young Adults, *Alcohol and Alcoholism*, 46, 709-713.

31. Bond, J., Ye, Y., Cherpitel, C. J. et al. (2010) The Relationship Between Self-Reported Drinking and BAC Level in Emergency Room Injury Cases: Is it a Straight Line?, *Alcoholism: Clinical and Experimental Research*, 34, 1118-1125.

Foundation for Alcohol Research & Education

Level 1
40 Thesiger Court
Deakin ACT 2600

PO Box 19
Deakin West
ACT 2600

www.fare.org.au

Centre for Alcohol Policy Research

54-62 Gertrude St
Fitzroy VIC 3065

www.capr.org.au

ISBN: 978-0-9875582-4-4