Examining Australia's heaviest drinkers

Michael Livingston,[1,2] Sarah Callinan[1]

Abstract

Objective: This study examined the distribution of alcohol consumption in Australia, identifying the heaviest drinking 10% of the population and examining their sociodemographic characteristics and their alcohol consumption and purchasing practices.

Methods: Data came from the 2016 National Drug Strategy Household Survey and the 2013 International Alcohol Control Study. The heaviest drinking 10% of the population identified based on estimates of annual alcohol consumption. Logistic regression was then used to assess the factors that distinguished these heaviest drinkers from the rest of the drinking population.

Results: The heaviest drinking 10% of the population consumed 54.4% of all alcohol consumed. These heavy drinkers were more likely to be men and to live in regional and remote areas. They were more likely to drink cask wine and full-strength beer and to purchase cheaper alcohol than other drinkers.

Conclusions: Australian alcohol consumption is heavily skewed. Alcohol consumption practices appear to differentiate the heaviest drinkers from others more clearly than sociodemographic factors.

Implications for public health: Public health interventions that reduce drinking among the heaviest 10% of drinkers in Australia have the potential to markedly reduce per-capita consumption and reduce alcohol-related harm. Interventions focused on cheap alcohol may be effective with these drinkers.

Key words: alcohol, surveys, alcohol policy

Research in several settings has demonstrated that alcohol consumption in the general population is highly skewed.[1] Historical analyses of the distribution of drinking in numerous countries consistently show a stark concentration of consumption among the heaviest drinkers even across countries with markedly different levels of consumption.[1,2] Much of the early work on this topic has focused on theory development rather than the specific distribution of drinking.[2] Studies specifically looking at the amount of alcohol consumed by the heaviest drinkers have produced broadly similar results. In the US, Kerr et al.[3] found that the heaviest 10% of drinkers consumed 55% of all alcohol. More recently, UK researchers have shown that the heaviest drinking 4% of the population in the UK drank 30% of all alcohol consumed and contributed to 23% of industry revenue.[4]

In this study, we will examine the distribution of alcohol consumption in Australia, especially focusing on identifying the heaviest drinking 10% of the Australian population. While the highly skewed nature of the drinking distribution has been understood for a long time, there remains little research that explores the characteristics and drinking behaviours of those at the very top of the distribution. Most studies (e.g. Kuntsche et al.[5]) focus on people who drink above certain threshold levels (e.g. the Australian low-risk drinking guidelines[6,7]). These studies tend to find that Australians who drink above the low-risk drinking guidelines are more likely to be male, more likely to live outside of major cities and more likely to live in areas of higher socioeconomic status.[8] The relationship between age group and alcohol consumption has been changing – young adults have historically been the most likely to drink at risky levels, but in recent surveys the gap between those aged 18-29 and older adults has narrowed substantially.[8]

These studies genuinely rely on definitions based on certain levels of risk (usually national drinking guidelines), which tend to include a significant proportion of the population. For example, around one in four Australians reported drinking at risky levels in the most recent national survey.[8] As has been shown in US and UK studies discussed above, this group includes a smaller subset of people who drink at disproportionately high levels (e.g. in the US 10% of people drink more than half of all the alcohol consumed[3]). In this study, we are interested in better understanding who these very heaviest drinkers are, what and where they drink and the risk behaviours they engage in while drinking. This group is likely to be heavily over-represented in both acute and chronic harms from alcohol and thus clearly an important target for public policy.

Developing a clearer picture of these heavy drinkers will provide critical evidence both in terms of policies targeted at the population (e.g. by identifying beverages, settings and purchasing practices most utilised by these drinkers) and at the individual (by providing a clearer socio-demographic picture of who they are). Thus, this study has three major aims:

1. To examine the distribution of drinking in Australia and provide the first robust evidence of the proportion of alcohol consumed by the heaviest drinkers.

1. Centre for Alcohol Policy Research, La Trobe University, Victoria
2. Department of Neuroscience, Karolinska Institutet, Sweden
Correspondence to: Dr Michael Livingston, Centre for Alcohol Policy Research, La Trobe University, Bundoora, Victoria, 3086; e-mail: m.livingston@latrobe.edu.au
Submitted: October 2018; Revision requested: February 2019; Accepted: March 2019
The authors have stated they have no conflict of interest.

Aust NZ J Public Health. 2019; Online; doi: 10.1111/1753-6405.12901

2. To identify the sociodemographic characteristics of these heaviest drinkers.
3. To assess how key drinking and risk behaviours differ for these heaviest drinkers compared to other Australian drinkers.

Methods

Data sources

Data largely came from the 2016 National Drug Strategy Household Survey (NDSHS), a tri-annual survey of the Australian population focussing on alcohol and drug issues. The survey used a stratified multi-stage design to sample respondents aged 12 and over from around Australia (total n=23,441). For the NDSHS, geographic regions were initially sampled (with probability of selection proportional to population). Random dwellings were then selected within these regions following a comprehensive set of procedures including skip intervals, eligible and ineligible addresses, and dealing with blocks of flats and units. The person in the household with the most recent birthday was selected to complete the survey. Following recruitment, respondents were able to complete the survey either on a paper form, via the web or over the phone. The response rate for the 2016 survey was 51.1%, broadly consistent with previous survey waves.[9-11] Australians who were homeless, institutionalised or living in other non-residential settings were excluded from the sampling frame, as were households where respondents did not speak sufficient English to complete the survey. Data were weighted by age, sex and region to be representative of population estimates from the Australian Bureau of Statistics. Full survey details are available in the study report.[8] We excluded 12-13 year olds (n=322) from our study as they did not answer all questions in the survey.

For the final section on purchasing practices, we used data from the Australian arm of the International Alcohol Control Study, run in 2013. A total of 2,020 people agreed to participate in the study, a computer-assisted telephone interview with a general population sample reached by random digit dialling (RDD) to landlines (60%) and mobile phones (40%) with a response rate of 37.2%. Again, only respondents who spoke English were eligible for selection. Risky drinkers were oversampled (see Jiang et al.[12] for details) to provide a sufficient sample of heavy drinkers and were down-weighted in whole-of-sample analyses (based on the population prevalence of risky drinking in the 2013 NDSHS) to ensure representative estimates. Further weighting also adjusted for age, sex and region to ensure a representative sample. Of the 2,020 respondents, 1,789 reported consuming alcohol in the past 12 months – only these respondents were included in the analyses for this paper.

Measures

In the NDSHS, alcohol consumption was collected using the standard graduated quantity frequency measure used in previous NDSHS waves (e.g. Livingston and Dietze[13]). Respondents were asked how often they drank 20 or more standard drinks in a session, and then how often they drank between 11 and 19 drinks, and so on down to how often they drank 1-2 drinks. An estimate of total annual consumption volume for each respondent was derived by multiplying the mid-point of each volume category (e.g. for the 11-19 drinks category, a volume of 15 is used) by the mid-point of each frequency category (e.g. for 5-6 days per week, a frequency of 5.5*52 = 286 is used). Where respondents provided more than 365 drinking occasions, their heaviest 365 were used. The top volume category (20 or more drinks) was coded as 21 drinks. See Greenfield[14] for a more detailed explanation of this approach.

Other key measures from the NDSHS are listed below.

- Main drink type (respondents were asked to choose their 'main drink' out of a list of categories: cask wine, bottled wine, regular strength beer, mid-strength beer, low-strength beer, home-brewed beer, fortified wine, spirits, pre-mix spirits (can), pre-mix spirits (bottle), other mixed drinks).
- Drinking location (respondents were asked to specify all the locations that they usually drank alcohol out of a list of categories: own home, friend's home, party, restaurants/cafes, pubs/clubs, rave/dance parties, school/TAFE/university, workplace, public spaces, in a car, somewhere else).
- Risky behaviour while drinking (respondents were asked whether or not they had 'driven a motor vehicle', 'created a public disturbance or nuisance' or 'verbally abused someone' while drinking).

These measures were included as they were the most policy-relevant data available in the survey in terms of drinking and risk behaviours.

Basic measures of age, sex, rurality, employment status and household income were also examined as these have been shown to be related to risky drinking in previous studies.[8]

In the IAC, respondents were asked whether they ever drank alcohol in a range of different locations (e.g. their own home, pubs, restaurants etc.). For each location, they were then asked to describe what they drank during a usual drinking occasion at that location, providing drink types and quantities in the units that they would drink in. For example, they could say they drank six 'stubbies' of regular-strength beer, rather than being expected to know that this is approximately 8.4 Australian standard drinks. From this an estimate of total consumption could be calculated and the top ten per cent of drinkers were then identified. Questions about off-licence purchasing of alcohol were asked in a similar fashion: respondents were asked how often they purchase alcohol from a range of premises and what they usually purchase when they go. Information on the amount and cost of alcohol purchased allowed a cost per standard drink to be calculated (see Jiang et al.[12] for more detail on the alcohol consumption and purchasing measures in the IAC).

Analyses

We grouped the Australian population into 20 equal-sized groups, from the group that consumed the least alcohol (percentile 0) to the group that consumed the most (percentile 95). All drinkers had a random fraction of a standard drink added to their total yearly consumption between 0.00001 and 0.99999 in order to avoid clustering of groups around more popular drink amounts. We combined the top two groups into a single category, making up the heaviest-drinking 10% of the population. Basic descriptive analyses are then presented, including comparisons between the heaviest drinking 10% of the population and other drinkers (non-drinkers are excluded from these comparisons). The statistical significance of differences between groups in Table 2 was assessed using the conservative approach of non-overlapping 95% confidence intervals. Analyses comparing the heaviest consumers with other drinkers in the IAC dataset used adjusted Wald tests of means or Stata's pretest as and when

appropriate. All analyses presented below use weighted data.

Results

Table 1 shows the distribution of drinking in Australia from the 2016 NDSHS. The bottom four groups (making up 20% of the population) were abstainers and consumed no alcohol. The heaviest drinkers consumed disproportionately large amounts of alcohol, with the top 5% consuming more than one-third of all alcohol.

The heaviest drinking 10% of the Australian population consumed 54.4% of all the alcohol in 2016. Respondents in this group consumed *at least* 3.1 standard drinks per day, placing them well above the Australian low-risk drinking guideline of 2 drinks per day.

Table 2 shows some key characteristics of these heavy drinkers compared to other drinkers in Australia (abstainers are excluded from these analyses). The top 10% of drinkers were more likely to be male, were slightly more likely to be aged between 40 and 69 years and were less likely to be 14-17 or 70+ years old. The heaviest drinkers were less likely to live in major cities.

In the simple bivariate analyses, the top 10% of drinkers were disproportionately likely to live in regional areas. For example, 16% of the heaviest drinkers lived in outer regional and remote areas, compared with 10% of other drinkers.

Table 1: The distribution of alcohol consumption in Australia, 2016 NDSHS.

Percentile	Average litres of pure alcohol per year	Proportion of all alcohol consumed
0	0.0	0.0%
5	0.0	0.0%
10	0.0	0.0%
15	0.0	0.0%
20	0.01	0.0%
25	0.05	0.1%
30	0.12	0.1%
35	0.25	0.3%
40	0.53	0.5%
45	0.99	1.0%
50	1.61	1.6%
55	2.25	2.3%
60	3.09	3.1%
65	3.96	4.0%
70	5.29	5.3%
75	6.70	6.8%
80	8.41	8.5%
85	11.99	12.1%
90	17.59	17.8%
95	36.24	36.6%

The 'main drinks' reported by the heaviest drinking 10% and other drinkers are also reported in Table 2. The heaviest drinkers were more likely to identify cask wine and all categories of beer as their main drink than other drinkers and less likely to identify bottled wine, spirits, pre-mixed spirits and cider. Heavy drinkers were also more likely to report drinking in their own home, at pubs and clubs, raves and dance parties, at work and in public places like parks. In terms of risk behaviours, they were three times as likely as other drinkers to report driving under the influence of alcohol and around five times more likely to report causing public disturbances or verbally abusing sometime.

Table 3 shows the results of a logistic regression examining which drinking and sociodemographic factors are most strongly associated with being in the heaviest drinking group. Reference groups were selected for ease of interpretation (e.g. using an age group in the middle of the distribution allowed us to see groups both significantly lower and significantly higher than the reference group). As the drinking location question allowed for multiple responses, the reference category

Table 2: Key characteristics of the heaviest drinking 10% of the Australian population, compared with other drinkers, 2016 National Drug Strategy Household Survey.

		Top 10% of drinkers % (95% CI)	Other drinkers % (95% CI)	
Sex	Male	74.1% (72.0%–76.0%)	47.5% (46.5%–48.5%)	*
	Female	25.9% (24.0%–28.0%)	52.5% (51.5%–53.5%)	*
Age	14-17	0.3% (0.1%–0.7%)	6.4% (5.9%–6.9%)	*
	18-24	11.1% (9.3%–13.1%)	11.8% (11.2%–12.5%)	
	25-29	8.9% (7.5%–10.5%)	8.7% (8.2%–9.3%)	
	30-39	18.5% (16.7%–20.5%)	16.9% (16.3%–17.5%)	
	40-49	18.9% (17.1%–20.9%)	16.0% (15.4%–16.6%)	*
	50-59	19.0% (17.2%–20.8%)	14.9% (14.3%–15.5%)	*
	60-69	14.4% (13.1%–15.9%)	12.4% (12.0%–12.9%)	*
	70+	9.0% (7.9%–10.1%)	12.9% (12.4%–13.4%)	*
Rurality	Inner City	61.4% (59.1%–63.6%)	71.2% (70.6%–71.8%)	*
	Inner Regional	22.7% (20.8%–24.8%)	18.4% (17.9%–18.9%)	*
	OR&R	15.9% (14.3%–17.7%)	10.4% (10.0%–10.9%)	*
Neighbourhood disadvantage	1 (least advantaged)	19.4% (17.6%–21.3%_	18.0% (17.2%–18.7%)	
	2	20.2% (18.3%–22.2%)	20.0% (19.2%–20.8%)	
	3	19.6% (17.8%–21.6%)	19.7% (18.9%–20.5%)	
	4	20.6% (18.7%–22.6%)	20.9% (20.2%–21.7%)	
	5 (most advantaged)	20.2% (18.4%–22.2%)	21.4% (20.7%–22.2%)	
Employment status	Not in the labour force	21.8% (20.0%–23.6%)	27.0% (26.2%–27.8%)	*
	Unemployed	7.5% (6.1%–9.1%)	7.4% (6.8%–7.9%)	
	Employed	70.7% (68.6%–72.9%)	65.7% (64.7%–66.5%)	*
Main Drink Type	Cask wine	5.2% (4.3%–6.2%)	2.3% (2.0%–2.5%)	*
	Bottled wine	23.6% (21.8%–25.6%)	36.1% (35.2%–36.7%)	*
	Regular strength beer	36.5% (34.1%–38.9%)	17.3% (16.5%–18.1%)	*
	Mid strength beer	11.6% (10.1%–13.2%)	7.3% (6.7%–7.8%)	*
	Low alcohol beer	4.2% (3.8%–4.6%)	2.3% (1.7%–3.2%)	*
	Pre-mixed spirits	5.7% (4.6%–7.1%)	9.7% (9.1%–10.4%)	*
	Bottled spirits	11.4% (9.9%–13.2%)	15.3% (14.6%–16.0%)	*
	Cider	1.8% (1.1%–2.8%)	5.1% (4.6%–5.6%)	*
Regular Drinking Location	Home	91.5% (89.9%–92.9%)	75.6% (74.8%–76.5%)	*
	Friend's home	39.4% (37.0%–41.9%)	36.8% (35.7%–37.6%)	
	Parties	34.2% (31.8%–36.6%)	32.5% (31.6%–33.5%)	
	Raves/dance parties	7.7% (6.2%–9.4%)	4.7% (4.2%–5.1%)	*
	Restaurants/cafes	36.5% (34.1%–38.8%)	39.5% (38.6%–40.4%)	
	Pubs/clubs	47.6% (45.2%–50.1%)	36.7% (35.7%–37.6%)	*
	Work	4.9% (3.9%–6.1%)	2.3% (2.1%–2.7%)	*
	Public places (parks/beaches etc.)	6.7% (5.5%–8.1%)	2.2% (1.9%–2.5%)	*
Risk behaviours	Driving under the influence	23.4% (21.4%–25.5%)	7.2% (6.8%–7.7%)	*
	Causing a public nuisance	3.8% (2.9%–5.1%)	0.8% (0.6%–1.0%)	*
	Verbally abusing someone	9.6% (8.2%–11.3%)	1.5% (1.3%–1.8%)	*

Notes:

OR&R = Outer Regional and Remote

** = 95% confidence intervals do not overlap*

for each location is respondents who did not drink at that location.

Men and people from outside major cities were significantly more likely to be among the heaviest drinkers. There were few differences by age, with 14-17 year-olds less likely than 30-39 year-olds and 50-69 year-olds more likely. Economic variables had no relationship with whether a respondent was in the heaviest drinking group. Drinking behaviours were strongly associated with being in the heaviest drinking group.

Respondents whose main drink was cask wine were the most likely to be among the heaviest drinkers, while those who drank regular strength beer as their main drink were more likely than those who nominated any other beverage type. The heaviest 10% of drinkers were more likely to report drinking at home, drinking at raves or dance parties, drinking in pubs or bars, drinking at work and drinking in public places. They were less likely to report drinking in restaurants or cafes.

Table 3: Logistic regression examining the relationship associations of socio-demographic and drinking variables with membership of the heaviest drinking 10% of the population, 2016 National Drug Strategy Household Survey.

	Odds Ratio	95% Confidence Interval	
Men (reference)	1.00	n.a.	
Women	0.35	(0.31-0.40)	*
Age group			
14-17	0.18	(0.07-0.47)	*
18-24	0.92	(0.70-1.21)	
25-29	1.00	(0.78-1.29)	
30-39 (reference)	1.00	n.a.	
40-49	1.07	(0.89-1.29)	
50-59	1.29	(1.07-1.55)	*
60-69	1.28	(1.05-1.56)	*
70+	0.80	(0.62-1.03)	
Employment status			
Unemployed/Looking for work	1.22	(0.91-1.62)	
Currently employed	1.03	(0.88-1.22)	
Not in the labour force (reference)	1.00	n.a.	
Remoteness			
Major cities (reference)	1.00	n.a.	
Inner Regional	1.41	(1.21-1.63)	*
Outer Regional/Remote/Very Remote	1.74	(1.46-2.08)	*
Neighbourhood disadvantage quintile			
Most advantaged (reference)	1.00	n.a.	
2nd	0.93	(0.77-1.13)	
3rd	0.93	(0.77-1.12)	
4th	0.97	(0.80-1.18)	
Most disadvantaged	1.02	(0.84-1.25)	
Main drink			
Regular beer (reference)	1.00	n.a.	*
Cask wine	1.64	(1.25-2.16)	*
Bottled wine	0.57	(0.49-0.67)	*
Mid-strength beer	0.73	(0.59-0.89)	*
Light beer	0.32	(0.22-0.47)	*
Pre-mixed spirits	0.46	(0.35-0.61)	*
Spirits	0.51	(0.41-0.62)	*
Cider	0.27	(0.17-0.45)	
Drinking locations (each location's reference category is those who don't drink at that location)			
Drink at home	3.51	(2.84-4.34)	*
Drink at friends' homes	0.92	(0.78-1.07)	
Drink at parties	0.99	(0.85-1.16)	
Drink at raves/dance parties	1.78	(1.28-2.47)	*
Drink at restaurants/cafes	0.65	(0.56-0.75)	*
Drink at pubs/bars	1.80	(1.56-2.08)	*
Drink at work	1.37	(1.00-1.86)	*
Drink in public places	2.38	(1.77-3.20)	*

Note:

** p<0.05*

Finally, in order to examine purchasing patterns we used the IAC data, where respondents were asked about both purchasing and consumption patterns. Using this, we compared the heaviest 10% of Australian drinkers in that sample with other drinkers. There was some evidence that the heaviest drinkers favoured cheaper alcohol. The mean price they paid per standard drink for off-premise alcohol was $1.47, compared with $1.81 for other drinkers ($F(1,1684)=15.99$, $p<0.001$). Similarly, when we examined whether respondents purchased 20% or more of their alcohol below $1.30 per standard drink (based on the recently set minimum price in the Northern Territory), we found significant differences. Most of the heaviest drinkers (65%, CI 53%-75%) purchased at least 20% of their alcohol below $1.30 per drink, compared with 37% (CI 34%-41%) of other drinkers ($z=5.59$, $p<0.001$). We specifically examined cask wine (the cheapest form of alcohol in Australia) and found that a higher proportion of heavy drinkers consumption was cask wine than other drinkers (7.8% (4.0%-11.710.9%) compared with 1.7% (0.9%-2.4%)) ($F(1,1788)=9.72$, $p=0.002$).

Conclusions

Our analyses found that the drinking distribution in Australia is heavily skewed, with the heaviest drinking 10% of the population consuming more than half of all alcohol consumed. This is consistent with previous work overseas,[4] but is the first Australian study to quantify the significant contribution that heavy drinkers make to the alcohol market in Australia.

We attempted to identify sociodemographic and behavioural correlates of being among this heaviest drinking 10% of the population. Men and people from regional and rural areas were more likely to be among the heaviest drinkers. Men have historically consumed markedly more alcohol than women in Australia and there has been little narrowing of this gap in recent years.[15] Similarly, higher rates of drinking outside the major cities have been well established.[16] Somewhat surprisingly, and in contrast to some studies that looked at more inclusive measures of 'risky drinking', there were few other strong relationships with sociodemographic factors. While there were some significant differences between the age distributions of the heaviest drinkers and other drinkers, the substantive differences were relatively small.

For the socioeconomic variables analysed (employment status and neighbourhood disadvantage) there were no significant effects at all in the multi-variable model. The relationship between social class and alcohol consumption is complex[17] and the consistent over-representation of people from lower socioeconomic backgrounds in alcohol-related harm data[18-20] remains a puzzle and may be related to factors other than alcohol consumption.[21]

Importantly, we found very strong relationships between key drinking variables and being among the heaviest drinkers. Heavy drinkers favoured cask wine and full-strength beer and were more likely to drink at home than non-heavy drinkers. Furthermore, analyses of a second data set showed that the heaviest drinkers tended to purchase cheaper alcohol than non-heavy drinkers. These findings are consistent with research elsewhere that shows that cheap alcohol tends to be favoured by heavier drinkers[22,23] and that policies aimed at increasing the price of the cheapest alcohol can substantially reduce alcohol-related harm.[24] Our finding, that more than half of all alcohol is drunk by 10% of drinkers, would also provide support for any policy that was applied per drink, rather than per drinker. In other words, pricing policies – especially those that focus on cheap alcohol – may be the most effective way to reduce the drinking of heavy drinkers in Australia. Of course, these policies should be supplemented with other evidence-based interventions including brief interventions in primary care,[25] restrictions to trading hours late at night[26] and other population-based interventions.[27]

Our study has several limitations. It relies on self-reported alcohol consumption data, which has widely reported weaknesses, especially at the upper end of the distribution.[28-30] We have previously shown that the NDSHS provides broadly reliable measurement of population trends in drinking, but it is likely that our sample excludes some of the heaviest drinkers in the country either due to non-response bias or because they're excluded from sampling frames.[31] It is also worth noting that the data from the IAC were from 2013, while the NDSHS data were from 2016. Per capita consumption of alcohol in Australia fell by 3% between 2013 and 2016, so there may be some small differences in the two samples. However, our findings are likely to be broadly indicative of the characteristics of Australia's heaviest drinkers and point towards potential policy interventions focusing especially on cheap alcohol as a way of reducing harm from alcohol in Australia.

Implications for public health

The heaviest drinking 10% of drinkers in Australia consume a substantial proportion of all alcohol. Interventions that reduced this consumption would likely produce significant improvements in public health. Our findings – that these heavy drinkers purchase cheaper alcohol than other drinkers – suggest that interventions targeting cheaper alcohol may be effective with this group and provide further evidence that price-related interventions such as volumetric taxation[32] or minimum unit pricing[33] are worth exploring.

Acknowledgements

The Australian Institute of Health and Welfare manage the data collection and dissemination of the National Drug Strategy Household Survey and we are grateful to them for facilitating access to the data via the Australian Data Archive. The funding source for the International Alcohol Control data used in this article is the Australian National Preventive Health Agency (Grant Ref. 157ROO2011). The contents of this article are solely the responsibility of the authors and do not reflect the views of the Australian National Preventive Health Agency This research was part supported under Australian Research Council's Discovery Projects funding scheme (project number DP150101024). ML is supported by an NHMRC Career Development Fellowship (1123840) and SC is supported by an ARC Discovery Early Career Research Award (180100016). The Centre for Alcohol Policy Research is co-funded by the Foundation for Alcohol Research and Education, an independent, charitable organization working to prevent the harmful use of alcohol in Australia (http://www.fare.org.au).

References

1. Skog O-J. The Collectivity of drinking cultures: A theory of the distribution of alcohol consumption. *Br J Addict*. 1985;80(1):83-99.
2. Lemmens P, Tan ES, Knibbe R. Comparing distributions of alcohol consumption: Empirical probability plots. *Br J Addict*. 1990;85:751-8.
3. Kerr WC, Greenfield TK. Distribution of alcohol consumption and expenditures and the impact of improved measurement on coverage of alcohol sales in the 2000 National Alcohol Survey. *Alcohol Clin Exp Res*. 2007;31(10):1714-22.
4. Bhattacharya A, Angus C, Pryce R, Holmes J, Brennan A, Meier PS. How dependent is the alcohol industry on heavy drinking in England? *Addiction*. 2018;113(12):2225-32.
5. Kuntsche E, Rehm J, Gmel G. Characteristics of binge drinkers in Europe. *Soc Sci Med*. 2004;59(1):113-27.
6. National Health and Medical Research Council. *Australian Guidelines to Reduce Health Risks from Drinking Alcohol*. Canberra (AUST): NHMRC; 2009.
7. Havard A, Shakeshaft AP, Conigrave KM. Prevalence and characteristics of patients with risky alcohol consumption presenting to emergency departments in rural Australia. *Emerg Med Australas*. 2012;24(3):266-76.
8. Australian Institute of Health and Welfare. *2016 National Drug Strategy Household Survey - Detailed Report*. Canberra (AUST): AIHW; 2017.
9. Australian Institute of Health and Welfare. *2007 National Drug Strategy Household Survey - Detailed Findings*. Canberra (AUST): AIHW; 2009.
10. Australian Institute of Health and Welfare. *2010 National Drug Strategy Household Survey - Detailed Report*. Canberra (AUST): AIHW; 2011.
11. Australian Institute of Health and Welfare. *2013 National Drug Strategy Household Survey - Detailed Report*. Canberra (AUST): AIHW; 2014.
12. Jiang H, Callinan S, Room R. *Alcohol Consumption and Purchasing (ACAP) Study: Survey Approach, Data Collection Procedures and Measurement of the First Wave of the Australian Arm of the International Alcohol Control Study*. Melbourne (AUST): Centre for Alcohol Policy Research; 2014.
13. Livingston M, Dietze P. National survey data can be used to measure trends in population alcohol consumption in Australia. *Aust N Z J Public Health*. 2016;40(3):233-5.
14. Greenfield TK. Ways of measuring drinking patterns and the difference they make: Experience with graduated frequencies. *J Subst Abuse*. 2000;12(1-2):33-49.
15. Livingston M, Callinan S, Dietze P, Stanesby O, Kuntsche E. Is there gender convergence in risky drinking when taking birth cohorts into account? Evidence from an Australian national survey 2001-2013. *Addiction*. 2018;113(11):2019-28.
16. Miller PG, Coomber K, Staiger P, Zinkiewicz L, Toumbourou JW. Review of rural and regional alcohol research in Australia. *Aust J Rural Health*. 2010;18(3):110-17.
17. Bellis MA, Hughes K, Nicholls J, Sheron N, Gilmore I, Jones L. The alcohol harm paradox: Using a national survey to explore how alcohol may disproportionately impact health in deprived individuals. *BMC Public Health*. 2016;16(1):111.
18. Turrell G, Stanley L, de Looper M, Oldenburg B. *Health Inequalities in Australia: Morbidity, Health Behaviours, Risk Factors and Health Service Use*. Canberra (AUST): Australian Institute of Health and Welfare; 2006.
19. Najman JM, Williams GM, Room R. Increasing socioeconomic inequalities in male cirrhosis of the liver mortality: Australia 1981-2002. *Drug Alcohol Rev*. 2007;26(3):273-8.
20. Mackenbach JP, Stirbu I, Roskam A-JR, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. *N Engl J Med*. 2008;358(23):2468-81.
21. Smith K, Foster J. *Alcohol, Health Inequalities and the Harm Paradox: Why Some Groups Face Greater Problems Despite Consuming Less Alcohol*. London (UK): Institute of Alcohol Studies; 2014.
22. Meier PS, Purshouse R, Brennan A. Policy options for alcohol price regulation: The importance of modelling population heterogeneity. *Addiction*. 2010;105(3):383-93.
23. Room R, Callinan S, Livingston M. Who buys low-price alcohol? First results from an australian consumption and purchasing study. *Drug Alcohol Rev*. 2013;32:61.
24. Wagenaar AC, Tobler AL, Komro KA. Effects of alcohol tax and price policies on morbidity and mortality: A systematic review. *Am J Public Health*. 2010;100(11):2270-8.
25. Kaner EF, Beyer FR, Muirhead C, Campbell F, Pienaar ED, Bertholet N, et al. Effectiveness of brief alcohol interventions in primary care populations. *Cochrane Database Syst Rev*. 2018 Feb 24;2:CD004148.

26. Wilkinson C, Livingston M, Room R. Impacts of changes to trading hours of liquor licences on alcohol-related harm: A systematic review 2005–2015. *Public Health Res Pract*. 2016;26(4). pii: 2641644.
27. Babor T. Alcohol: no ordinary commodity: research and public policy. *Addiction*. 2010;105(5):769-79.
28. Gmel G, Rehm J. Measuring alcohol consumption. *Contemp Drug Probl*. 2004;31:467-540.
29. Gmel G, Graham K, Kuendig H, Kuntsche S. Measuring alcohol consumption-should the'graduated frequency 'approach become the norm in survey research? *Addiction*. 2006;101(1):16-30.
30. Livingston M, Callinan S. Under-reporting in alcohol surveys: Whose drinking is under-estimated? *J Stud Alcohol Drugs*. 2015;76(1):158-64.
31. Mäkelä P, Huhtanen P. The effect of survey sampling frame on coverage: The level of and changes in alcohol-related mortality in Finland as a test case. *Addiction*. 2010;105(11):1935-41.
32. Vandenberg B, Livingston M, Hamilton M. Beyond cheap shots: Reforming alcohol taxation in Australia. *Drug Alcohol Rev*. 2008;27(6):579.
33. Holmes J, Meng Y, Meier PS, Brennan A, Angus C, Campbell-Burton A, et al. Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: A modelling study. *Lancet*. 2014;383(9929):1655-64.