

Citation

Marzan, M. and Callinan, S. and Livingston, M. and Jiang, H. 2022. Alcohol consumption, heavy episodic drinking and the perpetration of antisocial behaviours in Australia. *Drug and Alcohol Dependence*. 235: ARTN 109432. <http://doi.org/10.1016/j.drugalcdep.2022.109432>

Alcohol consumption, heavy episodic drinking and the perpetration of antisocial behaviours in Australia

Author Name(s)

Melvin Marzan^{*1,5}, Dr Sarah Callinan¹, Assoc/Prof Michael Livingston^{1,2,4}, and Dr Heng Jiang^{1,3,6}

¹*Centre for Alcohol Policy Research (CAPR), School of Psychology and Public Health, La Trobe University, Melbourne, Australia*

²*Department of Clinical Neurosciences, Karolinska Institutet, Stockholm, Sweden*

³*Centre for Health Equity, Melbourne School of Population and Global Health, University of Melbourne, Melbourne, Australia*

⁴*National Drug Research Institute (NDRI), Curtin University, Perth, Australia*

⁵*Department of Obstetrics and Gynaecology, Melbourne Medical School, University of Melbourne, Melbourne, Australia*

⁶*Department of Public Health, School of Psychology and Public Health, La Trobe University, Melbourne, Australia*

*Corresponding Author: m.marzan@latrobe.edu.au

ABSTRACT

Aims: This study aims to understand the dose-response relationship of the volume and patterns of alcohol consumption with alcohol-related antisocial behaviours (ASB) in the general population and assess whether these relationships are consistent across various sociodemographic subgroups.

Methods: We used data from 30,275 respondents aged (14-69) from two waves (2013 and 2016) of the National Drug Strategy Household Survey (NDSHS). Average daily alcohol consumption and heavy episodic drinking (HED) frequencies were treated as the main independent variables and self-reported ASB perpetration as the dependent variable. Bivariable and multivariable logistic regression models

predicting ASB with interaction terms between alcohol consumption and various sociodemographic variables were estimated.

Findings: Compared with low-risk drinking (.01-20 grams of alcohol/day), respondents drinking at risky (20.01-40 grams of alcohol/day) and high risk (>40 grams of alcohol per day) levels had an increased prevalence of ASB perpetration with adjusted odds ratios of 3.63 (95% CI 2.98-4.42) and 8.07 (6.72-9.71). Increasing frequency of HED was also linked to increased self-report of ASB perpetration in bivariable and multivariable models. In our interaction models, we found higher probabilities of ASB perpetration among younger and unmarried respondents for a given level of drinking.

Discussion and Conclusions: Both average daily alcohol consumption and frequency of HED predict the probability of perpetrating alcohol-related ASB. Unsurprisingly, the risk of alcohol-specific ASB increased more quickly with consumption levels for younger and single respondents, suggesting interventions to reduce consumption among younger and unmarried persons will significantly impact ASB.

Keywords: Alcohol, antisocial behaviours, heavy episodic drinking, dose-response analysis, Australia

WORD COUNT: 4,348

BACKGROUND

In 2016, alcohol consumption led to more than 2.8 million deaths globally and was one of the leading risk factors for premature death and disability for 15-49-year-olds (Griswold et al., 2018). These harms include a range of alcohol-related acute and chronic health conditions and injuries, such as liver cirrhosis, mental disorders, cancers, suicide, traffic injuries and assaults (Rehm et al., 2010). Acute harms from alcohol use also affect people other than the drinkers through violence, assault, aggression and fear (Room et al., 2010). There are no official statistics on alcohol-related antisocial behaviours (ASB) in Australia. However, according to a cross-sectional survey done in 2008, 70% of respondents reported that they experienced fear, nuisance and abuse due to the alcohol consumption of their friends, family or strangers (Laslett et al., 2011). The types of ASB that they might have experienced range from simple disturbances such as noise or social isolation to the more serious ASB such as physical, verbal and sexual abuse (Laslett et al., 2011).

The relationship between alcohol consumption and the perpetration of violence, aggression, and assault has been relatively well studied (Siciliano et al., 2013). Studies in the US, Germany, Spain, and Australia (Harford et al., 2005; Javier Álvarez et al., 2006; Kraus et al., 2009; Kraus et al., 2019; O'Brien, Kolt, Martens, Ruffman, Miller, & Lynott, 2012) found that alcohol is a significant risk factor in committing a wide range of antisocial behaviours (ASB) such as aggression, physical or verbal fights and assaults, violent arguments with or without physical fights, property damage, and sexual assaults (Harford et al., 2005; Javier Álvarez et al., 2006; Kraus et al., 2009; Kraus et al., 2019; O'Brien, Kolt, Martens, Ruffman, Miller, & Lynott, 2012). Epidemiologic studies show that alcohol use precedes ASB perpetration and that heavy drinking is correlated with harms to both victims and perpetrators (Cherpitel et al., 2012) and reviews show that drinking alcohol plays a role in almost half of key ASB like violence and sexual assaults (Darke, 2010; Testa, 2002). Although alcohol-related violence has been a significant concern for researchers and policymakers (Javier Álvarez et al., 2006; Kraus et al., 2009; Kraus et al., 2019), alcohol is linked to a broader range of ASB, including theft, property damage, and aggression. While these are generally less severe harms, they are much more prevalent, and studies that seek to

understand the impact of alcohol and alcohol policies need to consider them alongside a specific focus on violence.

A few studies have looked at the links between general drinking habits and involvement in these broader types of ASB. For example, Yang and colleagues found that people who reported more frequent alcohol drinking were more likely to report perpetration of ASB, like public disturbance, physical and verbal abuse, property damage, and theft (Yang et al., 2016). Another study of Australian adolescents showed that alcohol use was associated with increased odds of antisocial and violent behaviours (Williams et al., 2009). A study among sportspeople showed that heavy episodic drinking (HED) was associated with a higher risk of ASB perpetration, such as aggression, property damage and sexual assaults (O'Brien, Kolt, Martens, Ruffman, Miller, Lynott, et al., 2012). However, these studies relied on targeted samples, limiting their findings' generalisability (O'Brien, Kolt, Martens, Ruffman, Miller, & Lynott, 2012; Williams et al., 2009), and none of them thoroughly examined the dose-response relationship between alcohol consumption and ASB perpetration (O'Brien, Kolt, Martens, Ruffman, Miller, & Lynott, 2012; Williams et al., 2009). It is crucial to understand the dose-response association between alcohol consumption and ASB perpetration outcomes since policy measures to reduce ASB can depend on relationship patterns (Rehm et al., 2021). For example, suppose the dose-response relationship is linear. In that case, interventions to decrease per capita alcohol consumption such as taxation may be the most effective (Rehm et al., 2021). However, if the dose-response relationship is exponential and steep, interventions targeting heavy drinkers may be more effective (Rehm et al., 2021).

Moreover, there is a need to look at the relationship between alcohol consumption and ASB within population subgroups. The disproportionately higher rates of ASB in some subgroups - for example, in younger drinkers or men, may warrant further examination. Current studies contend that the higher risk of ASB perpetration in particular subgroups simply reflects heavier drinking in those groups (Bloomfield, 2020; O'Brien, Kolt, Martens, Ruffman, Miller, & Lynott, 2012). However, the literature also suggests some groups are at higher risk of ASB perpetration even adjusting for their drinking

behaviour (Bloomfield, 2020). Hence, it is essential to analyse sociodemographic and socioeconomic subgroups when studying the relationship between alcohol consumption and ASB perpetration.

Several studies have shown identified key socio-cultural or sociodemographic factors that influence the relationship between drinking behaviour and outcomes (Room, 2001; Room et al., 2010; World Health, 2011). Generally, the links between drinking and violence vary markedly between genders (Bratberg et al., 2016), due to a range of biological, cultural and social reasons (cite MEQUE and WILSNACK HERE). Age and marital status have also been shown to be significant predictors of alcohol-related aggression or social harms globally and in Australia (Livingston, 2014; Miller et al., 2011; Zinkiewicz et al., 2016) and may influence the risk of ASB over and above someone's drinking patterns. Alcohol-related social harms appear to be more common among younger drinkers. Young people are more likely to engage in risky behaviours [28], but it is unclear if this applies to ASB perpetration. It is not entirely clear how marital status modifies the risk of alcohol-related social harms; however, an Australian study suggested it might partly be associated with married subjects' better mental health status when compared against unmarried and separated respondents (Liang & Chikritzhs, 2012). The social support provided by a partner through direct spousal interactions might also be a protective factor against alcohol-related ASB (Kendler et al., 2016).

Another essential aspect to consider is the relationship between socioeconomic status (SES) and alcohol-related social harm outcomes. Several studies have shown that lower SES groups tend to be more vulnerable to problems from alcohol than would be expected on their drinking levels (Beard et al., 2016; Bloomfield, 2020; Sadler et al., 2017). Here, we explore whether this is the case for alcohol-related ASB. However, SES is a complicated indicator or predictor variable; for example, a study in England found that a single measure of SES has inadequate power to reflect SES accurately (Beard et al., 2016). To address this, we use different population-based measures (area disadvantage) and individual-based SES indicators such as household income, highest educational attainment, and employment.

Taken together, there are currently inadequate studies that robustly assess the relationship of both non-violent and violent types of ASB and alcohol consumption. Furthermore, the dose-response relationship between ASB and alcohol consumption have not been widely explored using subgroup analysis. Understanding the dose-response relationship between alcohol consumption and ASB and how this varies in different population sub-groups can inform estimates of alcohol policy impacts. For example, our initial work (Jiang et al., 2019) estimated the impacts of pricing policies on consumption in different groups – the relationships estimated here would allow for more robust modelling of policy impacts on ASB rates. Therefore, the aims of the current study are

1. To examine dose-response associations of average daily alcohol consumption and HED frequencies with the perpetration of selected alcohol-related ASB;
2. To determine the roles of sociodemographic and economic factors in the relationship between alcohol consumption and alcohol-related ASB.

METHODS

Participants and Procedures

Data from the 2013 and 2016 waves of the National Drug Strategy Household Survey (NDSHS) (Australian Institute of Health & Welfare, 2013, 2017) was used in this study. The NDSHS is conducted every three years and gathers data on the use, attitudes, and behaviour towards licit and illicit drugs from Australians aged 14 years old and above (Australian Institute of Health & Welfare, 2013, 2017). The NDSHS used multistage random sampling and was stratified by geographical locations (15 strata—capital city and the rest of the state for each of the six Australian states and the Northern Territory, and a single stratum for the Australian Capital Territory) (Australian Institute of Health & Welfare, 2013, 2017). Further details on data collection, sampling and methodologies were described elsewhere (Australian Institute of Health & Welfare, 2013, 2017). The response rates for the two waves we used here were 51% for 2016 (Australian Institute of Health & Welfare, 2017) and 49% for 2013 (Australian Institute of Health & Welfare, 2013). Both survey waves used drop and collect data collection, whereby a hardcopy of the questionnaire is left with the respondent and collected later. In 2016 respondents were

also able to respond online. (CATI) (Australian Institute of Health & Welfare, 2013, 2017). Data from 2013 and 2016 waves were combined, ensuring a sufficiently large sample to examine how risk varies across population sub-groups for these relatively low prevalence behaviours.

There were 23,521 records in the 2013 survey and 23,425 in 2016. We first excluded records of (respondents) 70 years old and above because older people are more vulnerable to the effects of alcohol due to their advanced age, more prevalence of comorbidities, cognitive and physical issues - meaning the links between ASB perpetration and alcohol consumption would be hard to assess within this group (n=4,673) (Han & Jia, 2021). As we focused on alcohol-related ASB, we excluded abstainers (n=9,538). We also excluded those with missing alcohol consumption answers (n=2,640) and respondents with missing responses to the alcohol-related ASB questions (n=1,318). After these exclusions, a total of (n=30,275) records were available for analysis from the two waves combined: 2016 (n=14,810), 2013 (n=15,465). This sample included 16,173 women and 14,102 men with ages from 14 to 69 years old.

Measures

Participants were asked about their alcohol consumption in the previous 12 months. Respondents who had consumed alcohol in the past 12 months were identified as current drinkers. The graduated quantity frequency method was used to determine how often (every day, 5–6 days a week, 3–4 days a week, 1–2 days a week, 2–3 days a month, about 1 day a month, less often or never) drinkers had consumed a certain amount of alcohol measured by standard drinks (10 g pure alcohol) per drinking day (20 or more, 11–19, 7–10, 5–6, 3–4, 1–2, less than 1, or none) (Australian Institute of Health & Welfare, 2013, 2017). The estimated total annual alcohol consumption of respondents was obtained by multiplying the mid-point of every consumption volume category (e.g. for the 11–19 drinks category, a volume of 15 is used) with the mid-point of each frequency category (e.g. for 5–6 days per week, a frequency of $5.5 * 52 = 286$ is used) (Brick, 2006). When respondents provided more than 365 drinking episodes in the preceding year, their maximum drinking episodes were capped at 365 per year (please see (Brick,

2006) for more details). Average daily alcohol consumption was estimated by dividing this annual consumption by 365, with standard drinks converged to grams of pure alcohol.

Respondents were then classified into four groups based on their average daily alcohol consumption: abstainers, light to moderate (1-20 grams of alcohol/day), risky (20.01-40 grams of alcohol/day) and high risk (>40 grams of alcohol/day) drinkers. Along with this overall volume measure, we included a measure of heavy episodic drinking (HED). The Australian National Health and Medical Research Council (NHMRC) defined HED as consuming more than four standard drinks (SD) on a single occasion for healthy men and women (Australian Government National Health Medical Research Council, 2009). Respondents' frequency of HED over the last 12 month was grouped into never (0), less than monthly (1-11 occasions), monthly but less than weekly (12-51 occasions), weekly or more (52+).

The ASB measure was a composite outcome variable derived based on the question 'in the last 12 months, did you undertake the following activities while under the influence of or affected by alcohol?' Respondents answered 'yes' or 'no' for each of the following activities a) created a public disturbance or nuisance; b) caused property damage; c) stole money, goods or property; d) verbally abused someone, and e) physically abused someone. A respondent saying 'yes' to any of these items was coded as having engaged in ASB.

Sociodemographic covariates included age, sex, and marital status. Measures of SES were assessed via self report (household income, highest educational attainment, and employment status) and via the respondents postcode (Socioeconomic Indexes for Areas (SEIFA score) and rurality). SEIFA broadly serves as a composite indicator of local area disadvantage regarding peoples' access to social and material resources generated by the Australian Bureau of Statistics (ABS) (Pink, 2011).

Statistical Analysis

All analyses were weighted to account for the complex survey design and the sample's uneven representation compared to the population benchmarks (Australian Institute of Health & Welfare, 2013, 2017). We performed logistic regression to examine the relationship of alcohol consumption measures [(a) average daily alcohol consumption, and (b) HED] on ASB measures. Logistic regressions were run separately for each consumption measures. We performed a sensitivity analysis by separating our ASB measure into non-violent (public disturbance, damage to property and theft and violent (verbal and physical abuse) sub-measures to check if the relationship between alcohol consumption and ASB was consistent between subtypes of ASB (see supplementary materials).

The logistic regression models were restricted to participants who answered all the relevant items (alcohol consumption and antisocial behaviour measures). The multivariable logistic regression analyses for both the average daily alcohol consumption and HED controlled for sex, age group, household income, highest educational level, rurality, marital status, survey wave and SEIFA. These sociodemographic and socioeconomic factors were thought to influence the perpetration of ASB based on previous studies (Kraus et al., 2009; Livingston, 2014; O'Brien, Kolt, Martens, Ruffman, Miller, Lynott, et al., 2012). Odds Ratios (ORs) and adjusted ORs were reported with *p*-values and 95% CIs. To assess the relative contribution of the specific ASB items, we performed a fixed-effects meta-analysis to pool the odds ratios, determine each ASB category's relative weight, and produce forest plots. We measured the interaction effects of each of the above sociodemographic variables in separate models. The overall significance of each interaction term was tested using the Wald Test to compare the model with the interaction included against the base model with no interaction term.

We used a model that treated average daily alcohol consumption and annual frequencies of HED as categorical variables to see the dose-response association between drinking volume, frequencies of HEDs and ASB. The post-estimation commands 'margins' and 'marginplot' were used to generate dose-response graphs on each sociodemographic variable, average daily alcohol consumption, annual frequencies of HED and the perpetration of ASB as the outcome.

RESULTS

The proportion and distribution of the individual items that make up our ASB measure are shown in Table 1. The most-reported ASB type was verbal abuse. Please note that respondents could select more than one response; hence these categories were not mutually exclusive.

<Table 1 about here>

The summary statistics and characteristics of respondents included in the analyses are shown in Table 2. Our bivariable logistic regression analyses showed that the younger age group, men, those living in outer regional areas, never married, unemployed and lower level of education had higher odds of perpetrating ASB.

<Table 2 about here>

The results of multivariable logistic regression analyses are shown in Table 2. Results showed that respondents who consume alcohol at a daily average of risky levels have 3.63 ($P < 0.001$) increased odds to perpetrate ASB than those who drink at light to moderate amount. In comparison, high risky drinkers have 8 times higher odds of ASB perpetration when compared to light and moderate drinkers. In terms of HED frequency, compared to respondents who reported no HED, the odds of self-reported ASB perpetration were 2.82 ($P < 0.001$) times more for respondents who participated in HED at least yearly and 6.68 ($P < 0.001$) times higher for respondents who participated in HED monthly. The odds also significantly increased to 18.65 ($P < 0.001$) for respondents who participated in HED at weekly or more.

<Table 3 about here>

Both alcohol consumption measures (Figure 1) showed an apparent strong positive dose-response trajectory on the probability of ASB perpetration - that is, as the dose increased, so did the probability of ASB perpetration. The adjustment for socio-demographics had little impact on the overall relationship. In supplementary material, we show that all items contributed to our ASB score, with physical abuse perpetration having the highest impact on the overall results (see forest plot, supp figure X). Furthermore, our sensitivity analysis (supplementary table 1(?)) showed that the relationship between different doses of average daily alcohol consumption and HED and perpetration of ASB did not differ when segmented between non-violent (theft, public disturbance, property damage) and violent forms of ASB.

<Figure 1 about here>

The predicted probabilities for our fitted interaction terms on average daily alcohol consumption or frequencies of HED and various sociodemographic variables are shown in Figures 2 and 3. The Wald-test identified positive statistically significant interaction effects among all tested sociodemographic variables and daily alcohol consumption with the probability of ASB perpetration. For the HED interactions, all except household income were significant. Only age group and marital status showed consistent categorical variations on the dose-response visual plots of the probability of ASB perpetration. They were considered meaningful (see Fig 2). These dose-response curves showed that people in the 14-29 age group and unmarried respondents reported disproportionately higher probability

of alcohol-related ASB perpetration for a given level of drinking, with a particularly steep acceleration in risk for the youngest age group at heavy drinking levels.

<Figure 2 about here> **Daily Average Drinking volume

<Figure 3 about here> **HED

DISCUSSION

Our study found that the strong dose-response relationship of alcohol consumption and ASB holds for a wider range of alcohol-related ASB than just violence. In other words, the more alcohol people consume and the more often they engage in HED, the more likely they are to perpetrate alcohol-related ASB. Moreover, we found that this relationship holds for non-violent forms of ASB such as theft, public disturbance, and property damage in roughly the same way it does for violent forms of ASB like physical and verbal abuse.

In bivariable and multivariable models, our findings showed a steady positive dose-response relationship between alcohol consumption (average daily drinking volume and HED frequencies) and ASB. Moreover, our results are concordant with previous studies that found that acute consequences, such as injuries, accidents, and other social problems, are positively linked to drinking patterns and average daily drinking volume (Rehm et al., 2003; Room, 2001). The dose-response patterns we derived (which are incremental) were similar to the dose-response trajectories obtained with previous studies of similar social problems (Kraus et al., 2009) and violence (Cherpitel, 1993). Interestingly, there was a decrease in the proportion of Australians surveyed who reported perpetrating ASB; this is along with the notable decreases in long-term drinking and HED in 2016 compared to the 2013 survey (see supplementary table A). The decline in drinking and ASB found here are consistent with the other evidence that drinking has declined in Australia, especially among young people (Livingston et al.,

2018) and might have driven the reductions in the rates of ASB (Mojica-Perez et al., 2019). The reason for these trends remains the subject of significant research (Vashishtha et al., 2020).

All sociodemographic and economic factors tested, positively modified the relationship between average daily alcohol consumption, HED, and ASB perpetration. However, these interactions were only meaningful on age group and marital status when effects were plotted. These findings are consistent with the previous analyses done on the pooled NDSHS data from 2001 to 2010 by Yang and colleagues (Yang et al., 2016). This confirms the previous researchers' findings that the relationship between alcohol consumption and ASB perpetration is complicated and can be influenced by a range of individual characteristics like age and sex, and other sociodemographic variables (J. Rehm & G. J. J. o. s. a. Gmel, 2000; Rehm et al., 2003). While increased daily alcohol consumption and HED frequencies were associated with ASB perpetration across all subgroups - we found that the relationship is more pronounced among the younger age group, single respondents, and those people with lower levels of education. The latter is most likely a reflection of the relative youth of unmarried and high-school graduate respondents. The significantly disproportionate risk of antisocial behaviours among the younger age group might reflect the higher prevalence of harmful drinking beyond what has been measured among younger respondents or indicate higher rates of risky behaviours more broadly (Meque et al., 2020). In terms of marital status, an Australian study concluded that the disproportionately lower prevalence of alcohol-related risky behaviours among married people may be linked to better mental health of married individuals when compared to unmarried and separated respondents (Liang & Chikritzhs, 2012).

While we found statistically significant positive interactions between our measures of SES and ASB perpetration, the magnitude of the differences between groups was too small to have any real-world importance. These findings are consistent with previous analyses of risk behaviours in Australia and New Zealand (Huckle et al., 2010; Livingston, 2014), which find few differences in risk behaviour by SES status. It adds to the evidence that the alcohol-harm paradox or inequities are unlikely to be linked

to differing behaviours while drinking across SES groups. However, these findings may also demonstrate the limitations of cross-sectional survey in detecting SES nuances given that we rely on self-reported risk behaviours (Livingston, 2014) from surveys with relatively low response rates.

There are some limitations to this study. First, while the NDSHS is a general population survey, it excluded other groups that may have been more vulnerable to alcohol-related social harms, such as prisoners, soldiers, and homeless persons. Furthermore, we have excluded the ≥ 70 years old respondents since they generally have a lower prevalence of ASB perpetration and that the link between alcohol and ASB is complicated due to the existence of physiological changes related to age that decreases their tolerance and increases their sensitivity to alcohol (Wadd & Papadopoulos, 2014). There was also an inherent limitation of a cross-sectional survey to infer causality; hence the direct associations derived from this study must be treated with caution. Future research is recommended to use cohort surveys or linked records to establish a more robust causal relationship between alcohol consumption and ASB. Furthermore, survey responses to key items may have been influenced by social desirability biases mainly because most of the captured types of ASB were illegal (i.e., theft, public disturbance, physical assault). Recall bias is also common in self-report surveys, which may also mean underestimating our exposure and outcome measures. Our dose-response analyses performed in average daily alcohol consumption and HED frequencies categorised the continuous measures and could result in misclassification errors or inadequate power (Kraus et al., 2009). Moreover, SEIFA is a population-based SES measure prone to ecological biases. Lastly, a large percentage of the sample had missing responses to income questions, which may have influenced our findings in multivariable models.

Our study offers considerable strengths. The pooled sample size from two waves of the population-based survey gave us adequate power for the study. Furthermore, our methods were consistent with approaches proposed elsewhere (J. Rehm & G. Gmel, 2000) and allowed us to measure relationships between the varying dimensions of drinking and the perpetration of ASB. Further, the analysis of the

interactions between alcohol consumption and various socio-demographic and socio-economic covariates add nuance to our findings.

In conclusion, patterns and volume of alcohol consumption are both useful predictors of perpetrating various forms of ASB. The positive dose-response association of HED and average drinking volume with ASB imply that chronic and acute heavy or hazardous drinkers are more involved in alcohol-related ASB perpetration than moderate drinkers. Several sociodemographic factors modify the relationship between alcohol consumption and ASB, with particularly significant interactions between the younger and the unmarried subgroups. Population-level policies that reduce alcohol consumption are likely to reduce the burden of alcohol-related ASB such as violence, assault, aggression, theft or property damage, and public disturbance. Although, interventions that target younger and unmarried people may further help decrease the prevalence of alcohol-related ASB perpetration. Further research is also needed to determine the cost and extent of other alcohol-related social harms in Australia to inform future alcohol-control policies better. Lastly, the measurement of ASB perpetration in a cross-sectional survey such as NDSHS should include questions about ASB perpetration broadly alongside alcohol-specific measures to allow a more robust estimation of ASB attributed to alcohol consumption.

ACKNOWLEDGEMENT

The Australian Institute of Health and Welfare manages the data collection and dissemination of the National Drug Strategy Household Survey. We are grateful to them for facilitating access to the data via the Australian Data Archive. This work was supported by the Australian Government's National Health and Medical Research Council (NHMRC). It is part of the NHMRC funded project "The effects of various alcohol pricing policies on consumption, health, social and economic outcomes and health inequalities" (GNT1141325); MM and is supported by La Trobe Full Fee Research Scholarship and the Australian Government Research Training Program Scholarship. HJ is funded by the National Health and Medical Research Council Project Grant (GNT1141325) and Australian Research Council – Discovery Project Grant (DP200101781). SC is funded by the Australian Research Council -

Discovery Early Career Researcher Award (DE180100016). ML is supported by an ARC Future Fellowship (FT210100656).

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