



NOVA

University of Newcastle Research Online

nova.newcastle.edu.au

Powers, Jennifer; Duffy, Luke; Burns, Lucy; Loxton, Deborah; "Binge drinking and subsequent depressive symptoms in young women in Australia". Published in Drug and Alcohol Dependence Vol. 161, p. 86-94 (2016)

**Available from:** <http://dx.doi.org/10.1016/j.drugalcdep.2016.01.019>

© 2016. This manuscript version is made available under the CC-BY-NC-ND 4.0 license  
<http://creativecommons.org/licenses/by-nc-nd/4.0/>

**Accessed from:** <http://hdl.handle.net/1959.13/1322160>

## Accepted Manuscript

Title: Binge drinking and subsequent depressive symptoms in young women in Australia

Author: Jennifer Powers Luke Duffy Lucy Burns Deborah Loxton



PII: S0376-8716(16)00047-8  
DOI: <http://dx.doi.org/doi:10.1016/j.drugalcdep.2016.01.019>  
Reference: DAD 5902

To appear in: *Drug and Alcohol Dependence*

Received date: 29-10-2015  
Revised date: 20-1-2016  
Accepted date: 20-1-2016

Please cite this article as: Powers, Jennifer, Duffy, Luke, Burns, Lucy, Loxton, Deborah, Binge drinking and subsequent depressive symptoms in young women in Australia. *Drug and Alcohol Dependence* <http://dx.doi.org/10.1016/j.drugalcdep.2016.01.019>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

**Binge drinking and subsequent depressive symptoms in young women in Australia**

Jennifer Powers<sup>1\*</sup> jenny.powers@newcastle.edu.au, Luke Duffy<sup>1</sup>, Lucy Burns<sup>2</sup>, Deborah Loxton<sup>1</sup>

<sup>1</sup>Research Centre for Generational Health and Ageing, University of Newcastle, Callaghan 2308, Australia

<sup>2</sup>National Drug and Alcohol Research Centre, University of New South Wales, NSW 2052, Australia

\*Corresponding author at: Research Centre for Generational Health and Ageing, University of Newcastle, Callaghan 2308, Australia, Tel.: +61 2 40420677, Facsimile: +61 2 40420044.

**Highlights**

- Five distinct patterns of binge drinking identified in 16-21 year old women
- Binge drinking patterns ranged from very infrequent to extremely frequent
- Extremely frequent bingeing increased the risk of subsequent depressive symptoms
- Increased depressive symptoms still evident 1-6 years later and 10-15 years later

**ABSTRACT**

*Background:* The long-term impact of binge drinking on subsequent depressive symptoms is unclear. The aims were to identify longitudinal patterns of binge drinking and whether binge drinking preceded depressive symptoms in the short-term (1-6 years) and long-term (10-15 years).

*Methods:* Longitudinal data from 1996, 2000 and 2009 mailed surveys of 8,197 women in the 1973-78 cohort of the Australian Longitudinal Study on Women's Health. Latent class analysis was used to identify binge drinking patterns and logistic regression to estimate associations with subsequent depressive symptoms.

*Results:* Five binge drinking trajectories were identified with predicted proportions of women who were very infrequent (24%), fluctuating infrequent (17%), frequent (17%), very frequent (26%) or extremely frequent binge drinkers (16%) between 16 and 21 years. At 22-27 years, depressive symptoms were significantly higher for extremely frequent binge drinkers (31% versus 21% in the short-term; 22% versus 16%-18% in the long-term) than for less frequent bingers. Unadjusted odds of depressive symptoms were 1.70 (95% CI: 1.38; 2.08) times for extremely frequent binge drinkers than very infrequent bingers and were 1.30 (95% CI: 1.04; 1.63) after adjusting for demographics, relationships and experience of violence. At 31-36 years, the odds of depressive symptoms were 1.34 (95% CI: 1.09-1.64) times for extremely frequent than very infrequent binge drinkers, but were not significant after adjusting for relationships and violence.

*Conclusions:* Extremely frequent binge drinking (more than weekly) in late adolescence appears to elevate the risk of subsequent depressive symptoms in young women in their early twenties and thirties, emphasising the need for preventive strategies to curb binge drinking.

**KEYWORDS:** Alcohol; ALSWH; depression; drinking pattern; longitudinal; mental health

## 1. INTRODUCTION

Problematic alcohol use (Bendtsen et al., 2011) and mental health problems (Patel et al., 2007) are major public health issues. In any given year 20% to 25% of adults experience a mental health problem in the United States, England and Australia (Australian Bureau of Statistics, 2008; Kessler and Wang, 2008; National Centre for Social Research, 2009).

Problematic alcohol use is a major risk factor for early deaths and disabilities in the world (World Health Organization, 2009) and is estimated as responsible for 4.5% of the global burden of disease (World Health Organization, 2010). Both mental health problems and problematic alcohol consumption are highly prevalent among young people. Specifically, 26% of young adults experience high rates of mental health problems (Australian Bureau of Statistics, 2008) and between 28% and 54% of adolescents and young adults binge drink (five or more drinks on one occasion; Archie et al., 2012; Center for Disease Control And Prevention, 2012; Degenhardt et al., 2013). These issues have wide reaching effects on the families of adolescents and society in general (Archie et al., 2012).

Findings suggest that problematic alcohol use and depressive symptoms frequently co-occur (Bellos et al., 2013; Archie et al., 2012; Theunissen et al., 2011; Timko et al., 2008), although the temporal nature of this relationship is bi-directional, problematic alcohol use can lead to depressive symptoms and depression may lead to problematic alcohol use. The limited longitudinal research that has explored this relationship suggests that binge drinking might increase the risk of subsequent depression (Haynes et al., 2005; Paljarvi et al., 2009; Wang and Patten, 2002). However, the findings have not been consistent, and suggest the effects of alcohol may differ not only by level of binge drinking but also for men and women. While two long-term population studies found no association between depression and at least one binge drinking occasion (Bell and Britton, 2015; Bulloch et al., 2012), a study involving Finnish men and women aged 20-54 found a pattern of binge drinking involving

intoxications, hangovers or pass-outs preceded depressive symptoms five years later (Paljarvi et al., 2009). In two waves of the Canadian National Population Health Survey, women who reported binge drinking once a month or more had a higher risk of major depression two years later, but this was not the case for men (Wang and Patten, 2002). Conversely, Haynes and colleagues (2005) found that while men who had six or more drinks per occasion at least once a month had three times the risk of depression 18 months later, there was no excess risk for female binge drinkers. (Bell and Britton, 2015; Bulloch et al., 2012)

Alcohol use, commonly in the form of binge drinking, often starts during adolescence (Chassin et al., 2002) and increases into the early twenties, but this is not the case for all individuals (Brown et al., 2008). Several studies have identified four or five distinct patterns of binge drinking in early adolescence through to early adulthood (Chassin et al., 2002; Hill et al., 2000; Tucker et al., 2005). Whilst the relationship between problematic alcohol use and poor mental health appears greater in some population subgroups, to date there has been little work examining the effects of different patterns of binge drinking on the mental health of young women. This is an important gap, as not only do young women experience higher rates of mental health problems (Australian Bureau of Statistics, 2008), and binge drink at higher rates than older women (Powers et al., 2015), but the impact of binge drinking may be more problematic at a younger age, given the brain is continuing to develop at this time and alcohol use may impede aspects of this development (Zeigler et al., 2005). Given the dangers and increasing prevalence of binge drinking among young women (McPherson et al., 2004), there is need for greater awareness of the potential short and long-term consequences of binge drinking.

This large prospective study of young women examines: 1) any distinct longitudinal trajectories of binge drinking among young women between the ages of 16 and 21; 2) explores the characteristics of women with these binge drinking trajectories; and 3)

investigates whether earlier patterns of binge drinking precede depressive symptoms in the short-term and the longer term.

## **2. METHODS**

### *2.1. Participants*

Recruitment for, and construction of the cohort, has been described in detail elsewhere (Lee et al., 2005). Briefly, women born between 1973 and 1978 completed the first mailed survey of the Australian Longitudinal Study on Women's Health (ALSWH 1973-78 cohort) in 1996, with a response proportion of 41% (n=14247). The women were randomly selected from the Medicare (national health insurance) database, which covers all permanent residents of Australia. Women living in rural and remote areas of Australia were intentionally oversampled. Respondents were broadly representative of women of the same age in the 1996 Census with some over-representation of more educated women (Brown et al., 1999). The median number of doctor visits did not differ for respondents and non-respondents (Young et al., 1998). Participants have been resurveyed at approximately three-yearly intervals. The study is approved by the Human Research Ethics Committees of the Universities of Newcastle and Queensland. Informed consent was obtained from participants.

As the aims of the current paper were to examine longitudinal trajectories of binge drinking in women between the ages of 16 and 21 and their effects on depressive symptoms in the short-term (1-6 years later) and the long-term (10-15 years later), analyses were restricted to health data collected prospectively at the 1996, 2000 and 2009 surveys and binge drinking data collected retrospectively at the 2009 survey (Figure 1). Longitudinal trajectories of binge drinking between the ages of 16 and 21 years were identified for the entire sample of 8197 women who provided binge drinking data. The effects of binge drinking on subsequent depressive symptoms were investigated in subsets of these women when they were aged 22-27 years at the 2000 survey or aged 31-36 years at the 2009 survey (see figure 1). Women

demonstrating depressive symptoms at baseline were excluded (see Section 2.2.1), leaving 6579 women in the analyses.

## 2.2. Measures

*2.2.1. Depressive symptoms.* Two well-validated scales were used to measure mental health: the five item Mental Health Index (MHI) of the Medical Outcomes Study Short Form 36-item in the 1996 survey and the 10-item Center for Epidemiologic Studies Depression Scale (CESD10) in the 2000 and 2009 surveys. Both scales have good reliability with Cronbach's alpha greater than 0.75 (Andresen et al., 1994; Boey, 1999; Lee and Chokkanathan, 2008; McHorney and Ware Jr, 1995). Previous research has found good correlation between MHI and a short form of the CESD (McHorney and Ware Jr, 1995). The MHI measures five symptoms of psychological distress experienced in the last four weeks: nervousness, low mood, feeling calm and peaceful, feeling down, and feeling happy (Ware et al., 1994). Each item is scored on a six point scale from one for 'all of the time' to six for 'none of the time'. The scores are summed and then transformed to a scale between zero and 100, with higher scores indicating better mental health. The MHI has been shown to distinguish between groups differing in the presence and severity of psychiatric disorders (McHorney et al., 1993). A score of less than 53 for MHI has been assessed to be a valid indicator of depression (Silveira et al., 2005; Ware et al., 1994). As the CESD10 was not collected at baseline, this cut-off score was used to exclude women who already had depressive symptoms in 1996 (n=1618). At subsequent surveys in 2000 and 2009, the CESD10 was used as it was considered a better indicator of depression (Andresen et al., 1994). The CESD10 is not a diagnostic tool for depression but is a well-validated clinical screen for depression for use in the general population (Andresen et al., 1994). The CESD10 measures 10 depressive symptoms experienced in the last week including being bothered by things, having trouble concentrating, feeling depressed, feeling everything was an effort, having restless sleep and

feeling lonely (Andresen et al., 1994). Each item is scored on a four point scale from zero for ‘rarely or none of the time’ to three for ‘most or all of the time’. Sum scores range between 0 and 30, with higher scores indicating poorer mental health. A cut point of 10 or more on the CESD10 has been shown to be indicative of depression in a wide range of populations (Andresen et al., 1994), and was used to indicate depressive symptoms when the women were aged 22-27 years, and again between 31 and 36 years of age.

*2.2.2. Binge drinking.* The definition of binge drinking varies but commonly used definitions are five or more drinks on a single occasion for both men and women, or a reduction to four drinks for women (Courtney and Polich, 2009; Glassman, 2010). Some studies also include frequency to define binge drinking (Courtney and Polich, 2009). Based on risk of alcohol-related harm from injury, Australian alcohol guidelines advise that both men and women should drink no more than four standard drinks (10 grams alcohol per drink) on a single occasion (National Health and Medical Research Council, 2009), so five or more drinks on one occasion was used to define binge drinking in this study. At the 2009 survey, women were asked to retrospectively recall their binge drinking at each age between 16 and 21. Response options to the question, ‘How often did you have five or more drinks on one occasion’ were ‘never’, ‘less than once a month’, ‘about once a month’, ‘about once a week’ and ‘more than once a week’. These data were used to identify groups of women with different binge drinking trajectories between the ages of 16 and 21.

*2.2.3. Covariates.* The following factors known to be associated with risky drinking and depressive symptoms were adjusted for: demographics, relationships including experience of a violent relationship (France et al., 2004; Paljarvi et al., 2009; Powers et al., 2015; Rich et al., 2013). Demographic factors included age group (18-20 versus 21-23 years in 1996), area of residence (urban or not), education including study (12 years school or less; trade, certificate or diploma; non-tertiary and still studying; university), employed or not, and

monetary stress (very or extremely stressed about money or not). Factors describing relationships included relationship status (not partnered, living in a de facto relationship, married) and whether women had children living with them. Intimate partner violence has been found to be associated with depression (Rich et al., 2013) and risky drinking (Powers et al., 2015). Women reported whether they had ever been in a violent relationship with a partner or not.

### *2.3. Statistical analyses*

As the aim was to identify longitudinal trajectories of binge drinking at the population level, binge drinking data provided by all women were used. Groups of women with similar patterns of binge drinking between the ages of 16 and 21 (classes) were identified using longitudinal latent class analysis (LLCA). LLCA models were estimated using mixture models with maximum likelihood estimation and robust standard errors in Mplus version 7.3 (Muthen and Muthen, 1998-2010). To be sure that a true maximum likelihood and not a local maximum was reached, 1,000 random starts were used for each model estimation. Full information maximum likelihood was used to account for missing data under the assumption of missing at random (MAR). Models were run for up to 6 classes. For all models, the optimum number of classes was determined using the following criteria. The Bayesian information criteria (BIC) takes into account the log likelihood and the number of parameters estimated relative to the sample size. The adjusted Lo-Mendell-Rubin test (LMR) likelihood ratio test was used to test the difference between model fit for K versus K-1 classes. Entropy ranges from 0 to 1 and high values indicate clear class separation. Smallest class size was investigated to determine whether the parameter estimates were likely to be stable. The model with the chosen number of classes was investigated to ensure that each of the classes was interpretable. Women were assigned to their most likely class on the basis of estimated posterior probabilities.

Further analyses were conducted in SAS version 9.4 (SAS Institute Inc., 1999) and were weighted for the probability of being in their most likely class so that the uncertainty of class assignment was retained. The characteristics of the women at the 1996 survey in each of the classes were described and compared using chi square. As the remaining analyses aimed to investigate whether earlier patterns of binge drinking precede depressive symptoms, women who reported depressive symptoms at baseline were excluded. The proportions of women with depressive symptoms in each binge drinking class were compared using the MULTTEST procedure to account for multiple comparisons. Logistic regression models were used to investigate whether any of the identified binge drinking patterns at 16-21 years was likely to precede depressive symptoms at 22-27 years, and at 31-36 years. Models were adjusted for covariates collected at the same time as the measure of depressive symptoms. Demographics (area of residence, age group, education, employment and monetary stress) were added first, then relationship factors (relationship status, and living with children), and finally, experience of violence.

Sensitivity analyses were conducted using 10 multiply imputed datasets, providing relative efficiency of more than 95%. Missing data for individual variables were 0-2.0% at 22-27 years and 0-1.4% at 31-36 years, and 16.1% for non-respondents at 22-27 years. The MI procedure was used to impute missing data under the assumption that data were missing at random (Lee and Carlin, 2010). The imputation model included all variables used in the logistic regression models above: five identified binge drinking classes, probability of being in assigned class, demographics, relationship factors, depressive symptoms, and MHI at the 1996 survey. Results from the logistic regression models were combined using MIanalyze procedure.

### 3. RESULTS

Women were included in the analyses if they provided binge drinking data at the 2009 survey (n=8197). Participants at the 2009 survey were older (47% versus 43%) and more likely to have post-school education (32% versus 26%), and were equally likely to be employed and never married in 1996 than non-respondents. This means that participants still over-represented more educated women but otherwise were broadly representative of the women of the same age in the Census. Participants were less likely to have poor mental health (20% versus 25%) and were less likely to be non-drinkers (8% versus 12%) than non-respondents.

#### *3.1. Patterns of binge drinking*

Most of the 8,197 women provided data on binge drinking at each of the six ages between 16 and 21 years of age (8133 women (99.2%) provided data for all six ages, 32 women for five ages and the remaining 32 women for between one and four ages). Groups of women with similar patterns of binge drinking were identified using LLCA. The best log likelihood was replicated in LLCA models with up to six binge drinking classes. While the log likelihood and BIC suggested six classes fit the data, based on LMR the optimum number of binge drinking classes was five (Table 1). The higher entropy for the five class model suggested cleaner class separation for the five class model than the other models. Figure 2 shows the predicted proportions of women binge drinking at each frequency in each of the five classes with approximately 20% in each class. Almost all of the 24% of women in class 1 were labelled as ‘very infrequent bingers’ and includes those women who never binged and where, over time, a small proportion went on to binge drink. Class 2 (17%) was labelled as ‘fluctuating infrequent bingers’ and comprised women who mainly binged rarely throughout the study period, and where the proportion who did binge more frequently than this fluctuated over time. Class 3 (17%) was labelled ‘frequent bingers’, where the proportion of women

who binged increased over time until the majority were drinking on a monthly basis. Class 4 (26%) was labelled ‘very frequent bingers’, where the proportion of women who binged weekly increased from 7% at 16, until the majority were bingeing on a weekly basis. Class 5 (16%) was labelled ‘extremely frequent bingers’, where 21% were bingeing at least weekly at 16, with this proportion increasing until the majority were bingeing more than once a week. Accuracy of classification was high with entropy of 0.966; average latent class probabilities for the most likely binge class were 0.982 for very infrequent bingers, 0.977 for fluctuating infrequent bingers, 0.982 for frequent bingers, 0.981 for very frequent bingers and 0.988 for extremely frequent bingers.

In terms of demographics, very and extremely frequent bingers tended to be younger (55-56% versus 49-51%), employed (54-57% versus 51%) and more stressed about money (27-34% versus 18-22%) than infrequent bingers (Table 2). They were less likely to be married (4-5% versus 11-14%) and to have children living with them (3-4% versus 7-10%). Extremely frequent bingers were more likely to have experienced violence (16% versus 6%) than very infrequent bingers.

### *3.2. Binge drinking between 16 and 21 years and subsequent depressive symptoms*

In the short-term (1-6 years later) when the women were aged 22-27 years, the prevalence of subsequent depressive symptoms was significantly higher among extremely frequent bingers (30.6%) than among less frequent bingers (20.7%, 21.3%, 20.6%, 20.5%  $p < 0.01$ ; Table 3). The unadjusted odds of depressive symptoms were 1.7 times higher among extremely frequent bingers compared with very infrequent bingers. The odds of depressive symptoms remained significantly higher in extremely frequent bingers after adjusting for

demographics, relationship factors and experience of violence (Table 3, supplemental Table 1<sup>1</sup>).

In the long-term (10-15 years later) when women were aged 31 to 36 years, the prevalence of depressive symptoms was still significantly higher among extremely frequent bingers (22%) than among less frequent bingers (17.5%, 17.1%, 16.2%, 17.6%; Table 4). Extremely frequent bingers had 1.34 times the odds of depressive symptoms than very infrequent bingers. The odds remained significant after the model was adjusted for demographics, but not after adjusting for relationship factors and experience of violence (Table 4, supplemental Table 1<sup>2</sup>). Sensitivity analyses of 10 multiply-imputed datasets provided equivalent results in the short- and long-term (see supplemental Table 2<sup>3</sup>).

#### **4. DISCUSSION**

##### *4.1. Summary*

This study adds significantly to the evidence base on the impact of binge drinking on the mental health of young women by identifying longitudinal trajectories of binge drinking and the subsequent effects on depressive symptoms in both the short-term and the long-term. Two key findings emerged from this work. Firstly with respect to drinking trajectories, five distinct groups of women were identified: very infrequent bingers, infrequent bingers (binged rarely with some fluctuation to heavier bingeing), frequent bingers (increasing proportion bingeing monthly), very frequent bingers (increasing to weekly bingeing), and extremely frequent bingers (increasing to more than weekly bingeing). Secondly, extremely frequent binge drinking elevated the risk of subsequent depressive symptoms in both the short-term (1-6 years later) and in the long-term (10-15 years later). These associations remained

---

<sup>1</sup> Supplementary material can be found by accessing the online version of this paper at <http://dx.doi.org> and by entering doi:

<sup>2</sup> Supplementary material can be found by accessing the online version of this paper at <http://dx.doi.org> and by entering doi:

<sup>3</sup> Supplementary material can be found by accessing the online version of this paper at <http://dx.doi.org> and by entering doi:

significant after controlling for demographics, relationship factors and experience of violence in the short-term and after controlling for demographics in the long-term.

#### *4.2. Interpretation*

To date, work in this area has largely relied on the findings of cross-sectional studies. These have found associations between binge or heavy drinking and depression (Bazargan-Hejazi et al., 2008; Manninen et al., 2006; O'Donnell et al., 2006; Timko et al., 2008) but the direction of the association is unclear, given the nature of the study design. Prior to the present work there have been few longitudinal studies in the area and the results were mixed, with differing results shown in subgroups (Haynes et al., 2005; Wang and Patten, 2002).

This study specifically examined the impact of different patterns of binge drinking (very infrequent, fluctuating infrequent, frequent, very frequent and extremely frequent binge drinking) on depressive symptoms amongst young women in the short or long-term. Only extremely frequent binge drinking (more than weekly) resulted in an increase in depressive symptoms. The underlying level of depressive symptoms was approximately 21% among infrequent, frequent and very frequent binge drinkers, however among extremely frequent binge drinkers an extra 10% of young women reported depressive symptoms up to six years later. Although the elevated risk of depressive symptoms among extremely frequent binge drinkers had dropped to an extra 5% on average, it was still present up to 15 years later, suggesting an enduring impact of problematic alcohol use on mental health. These findings are consistent with those of previous studies, that found symptoms of binge drinking (intoxication, hangover and pass-out; Paljarvi et al., 2009), alcohol dependence (Bulloch et al., 2012), or alcohol abuse or dependence (Fergusson et al., 2009) preceded depression.

Taken together, the results suggest that there is a threshold for heavy and/or binge drinking at which the risk of depression not only increases but is sustained over time. This could be explained in part by the relationship between binge drinking and high risk

behaviours and injury (Brown et al., 2008; Powers et al., 2015). In addition, women who are extremely frequent bingers were most likely to have monetary stress and to have experienced partner violence, two factors that are known to contribute to depression (Loxton et al., 2006). Together these findings point to the need for integrated approach to interventions that includes consideration of mental health, problematic alcohol use and recovery from abuse.

Despite the exclusion of women with depressive symptoms at baseline, the reverse association is still possible (that poor mental health leads to binge drinking) and has been supported by several studies (Bell and Britton, 2014; Bell et al., 2015; Pape and Norström, 2015). Others have supported a bidirectional relationship between alcohol dependence and depression (Brière et al., 2014; Bulloch et al., 2012), or that heavy and/or binge drinking precedes depression (Fergusson et al., 2009; Paljarvi et al., 2009; Wang and Patten, 2002). Although this study only examined the unidirectional effect of binge drinking on depressive symptoms, other factors that may mask the relationship are unmeasured mental health and alcohol treatment, as well as women with milder depressive symptoms self-medicating by engaging in heavy drinking. Clearly the nature of the association is complex and further research is required.

The current research supports the hypothesis that extremely frequent binge drinking plays a role in the later onset of depressive symptoms in young women and this may occur through several mechanisms. Twin and family studies have found that alcohol misuse and depressive symptoms share genetic and environmental risk factors (Boschloo et al., 2011; Edwards et al., 2011). Social factors may include taking increased risks such as risky sexual behaviour, the increased risk of abuse or lower social support aggravated by excess alcohol. Extremely frequent bingeing may lead to poor work or study performance leading to monetary stress. While this study has controlled for some of these factors, it was not possible to adjust for potential neurobiological pathways between heavy drinking and depressive

symptoms. Whatever the mechanisms, young women should be made aware that what they do in their late adolescence may have long-reaching effects.

#### *4.3. Strengths and limitations*

As with any study, there are strengths and limitations. A major strength is that this study has 13 years of follow-up on a cohort, which is broadly representative of women of the same age in the Australian population. Although the initial response rate was low, the large sample size, diversity of the sample and the breadth of the data mean that the association between depressive symptoms and frequency of binge drinking are likely to apply to the population of young Australian women. Various studies have demonstrated that associations remain valid with response rates as low as 18%, (Mealing et al., 2010; Morton et al., 2012; Visser et al., 1996) and with differential loss to follow-up (Carter et al., 2012; Deeg, 2002; Powers and Loxton, 2010). Nevertheless, the possibility of differential response by depressed women across binge drinking categories exists. For example, non-response would be more likely among extremely frequent binge drinkers than among infrequent bingers, resulting in an underestimation of the odds of depressive symptoms among extremely frequent binge drinkers. Furthermore, the under-representation of less educated women at baseline and follow-up, as well as the higher attrition among those with poorer mental health, may also result in underestimates. As non-drinkers have been shown to have poorer psychological health than drinkers (Peele and Brodsky, 2000), the higher attrition of non-drinkers, and their inclusion in the infrequent binge class, may have underestimated the risk of depressive symptoms.

It is important to consider the limitations of the main measures. Depressive symptoms were measured by two different but well validated scales, MHI and CESD10. (Andresen et al., 1994; Boey, 1999; Lee and Chokkanathan, 2008; McHorney and Ware, Jr., 1995) Although this may result in some bias, both scales have good reliability and are highly

correlated (McHorney and Ware, Jr., 1995; Andresen et al., 1994; Boey, 1999; Lee and Chokkanathan, 2008) so there is little reason for them to behave differently across different patterns of binge drinking. Retrospective data on frequency of binge drinking between 16 and 21 years of age were collected when women were 31-36 years old. Several studies have examined retrospective collection of alcohol data (Alvik et al., 2006; Chu et al., 2010; Liu et al., 1996; Longnecker et al., 1992) and have found good agreement between concurrently reported alcohol intake and alcohol intake recalled up to 23 years later (Chu et al., 2010). A study of gynaecologic outpatients concluded that retrospective reports may be more accurate for heavy drinking (Czarnecki et al., 1990). While recall bias is a possibility, it is unlikely to differ by level of depressive symptoms (Kizilbash et al., 2002). Further, the data were collected via confidential mailed surveys, a method that has been shown to produce reliable reports of risky behaviour (Alvik et al., 2005). Although a single measure of binge drinking at the age of 18 or 19 may have reached a similar conclusion, longitudinal latent class analysis provided greater confidence that a true measure was obtained for binge drinking over the six years between 16 and 21.

#### *4.4. Conclusion*

A pattern of increasing extremely frequent binge drinking during late adolescence appears to increase the risk of subsequent depressive symptoms in both the short-term (1-6 years later) and long-term (10-15 years later). These findings clearly add to the evidence base noting the importance of public health initiatives to reduce problematic alcohol use amongst young women.

#### **Role of funding source**

The Australian Longitudinal Study on Women's Health is supported by grants from the Australian Government Department of Health. This work was supported by a grant from the New South Wales Department of Health Drug and Alcohol Council Research Grants Program. The funders had no role in the study design, data collection, analysis and interpretation of the data, preparation of the manuscript or decision to publish this

manuscript. JP had full access to all the data and takes responsibility for the integrity of the data and the accuracy of the data analyses.

**Conflict of interest**

No conflict declared.

**Contributors**

JP and DL conceived and designed the study. JP analysed the data. JP, DL and LD drafted the manuscript. JP, DL, LD and LB provided important intellectual content and contributed to the revision of the manuscript. All authors saw the final manuscript and agreed to submit the manuscript for publication.

**Acknowledgements**

The Australian Longitudinal Study on Women's Health is conducted by a team of researchers at the University of Newcastle and the University of Queensland. This work was supported by grants from the Australian Government Department of Health and the NSW Department of Health Drug and Alcohol Council Research Grants Program. We are grateful to the women who participate. The authors gratefully acknowledge the valuable contributions of all staff, students, and colleagues who have been associated with the project since its inception. Researchers in the Research Centre for Gender, Health and Ageing at the University of Newcastle are members of the Hunter Medical Research Institute.

**REFERENCES**

- Adamson, L., Chojenta, C., 2007. Developing relationships and retaining participants in a longitudinal study. *Int. J. Mult. Res. Approach.* 1, 137-146.
- Alvik, A., Haldorsen, T., Groholt, B., Lindemann, R., 2006. Alcohol consumption before and during pregnancy comparing concurrent and retrospective reports. *Alcohol. Clin. Exp. Res.* 30, 510-515.
- Alvik, A., Haldorsen, T., Lindemann, R., 2005. Consistency of reported alcohol use by pregnant women: anonymous versus confidential questionnaires with item nonresponse differences. *Alcohol. Clin. Exp. Res.* 29, 1444-1449.
- Andresen, E. M., Malmgren, J. A., Carter, W. B., Patrick, D. L., 1994. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *Am. J. Prev. Med.* 10, 77-84.
- Archie, S., Kazemi, A. Z., Akhtar-Danesh, N., 2012. Concurrent binge drinking and depression among Canadian youth: prevalence, patterns, and suicidality. *Alcohol* 46, 165-172.
- Australian Bureau of Statistics, 2008. National Survey Of Mental Health And Wellbeing: Summary Of Results, Australia 2007. Cat. No. 4326.0. Canberra.
- Bazargan-Hejazi, S., Bazargan, M., Gaines, T., Jemanez, M., 2008. Alcohol misuse and report of recent depressive symptoms among ED patients. *Am. J. Emerg. Med.* 26, 537-544.
- Bell, S., Britton, A., 2014. An exploration of the dynamic longitudinal relationship between mental health and alcohol consumption: a prospective cohort study. *BMC Med.* 12, 91.

- Bell, S., Britton, A., 2015. Drinking pattern during midlife and risk of developing depression during 28 years of follow-up: a prospective cohort study. *Drug Alcohol Depend.* 155, 111-117.
- Bell, S., Orford, J., Britton, A., 2015. Heavy drinking days and mental health: an exploration of the dynamic 10-year longitudinal relationship in a prospective cohort of untreated heavy drinkers. *Alcohol. Clin. Exp. Res.* 39, 688-696.
- Bellos, S., Skapinakis, P., Rai, D., Zitko, P., Araya, R., Lewis, G., Lionis, C., Mavreas, V., 2013. Cross-cultural patterns of the association between varying levels of alcohol consumption and the common mental disorders of depression and anxiety: secondary analysis of the WHO Collaborative Study on Psychological Problems in General Health Care. *Drug Alcohol Depend.* 133, 825-831.
- Bendtsen, P., Karlsson, N., Dalal, K., Nilsen, P., 2011. Hazardous drinking concepts, limits and methods: low levels of awareness, knowledge and use in the Swedish population. *Alcohol Alcohol.* 46, 638-645.
- Boey, K. W., 1999. Cross-validation of a short form of the CES-D in Chinese elderly. *Int. J. Geriatr. Psychiatry* 14, 608-617.
- Boschloo, L., Vogelzangs, N., Smit, J. H., Van Den Brink, W., Veltman, D. J., Beekman, A. T. F., Penninx, B. W. J. H., 2011. Comorbidity and risk indicators for alcohol use disorders among persons with anxiety and/or depressive disorders. Findings from the Netherlands Study of Depression and Anxiety (NESDA). *J. Affect. Disord.* 131, 233-242.
- Brière, F. N., Rohde, P., Seeley, J. R., Klein, D., Lewinsohn, P. M., 2014. Comorbidity between major depression and alcohol use disorder from adolescence to adulthood. *Compr. Psychiatry* 55, 526-533.

- Brown, S. A., Mcgue, M., Maggs, J., Schulenberg, J., Hingson, R., Swartzwelder, S., Martin, C., Chung, T., Tapert, S. F., Sher, K., Winters, K. C., Lowman, C., Murphy, S., 2008. A developmental perspective on alcohol and youths 16 to 20 years of age. *Pediatrics* 121, S290-S310.
- Brown, W. J., Dobson, A. J., Bryson, L., Byles, J. E., 1999. Women's health Australia: on the progress of the main cohort studies. *J. Womens Health Gend. Based Med.* 8, 681-8.
- Bulloch, A., Lavorato, D., Williams, J., Patten, S., 2012. Alcohol consumption and major depression in the general population: the critical importance of dependence. *Depress. Anxiety* 29, 1058-1064.
- Carter, K. N., Imlach-Gunasekara, F., Mckenzie, S. K., Blakely, T., 2012. Differential loss of participants does not necessarily cause selection bias. *Aust. N. Z. J. Public Health* 36, 218-222.
- Center for Disease Control and Prevention, 2012. Vital signs: binge drinking prevalence, frequency, and intensity among adults-United States, 2010. *MMWR* 61, 14.
- Chassin, L., Pitts, S. C., Prost, J., 2002. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: predictors and substance abuse outcomes. *J. Consult. Clin. Psychol.* 70, 67.
- Chu, A. Y., Meoni, L. A., Wang, N. Y., Liang, K.-Y., Ford, D. E., Klag, M. J., 2010. Reliability of alcohol recall after 15 years and 23 years of follow-up in the Johns Hopkins Precursors Study. *J. Stud. Alcohol Drugs* 71, 143.
- Courtney, K. E., Polich, J., 2009. Binge drinking in young adults: data, definitions, and determinants. *Psychol. Bull.* 135, 142-156.
- Czarnecki, D. M., Russell, M., Cooper, M. L., Salter, D., 1990. Five-year reliability of self-reported alcohol consumption. *J. Stud. Alcohol.* 51, 68-76.

- Deeg, D. J., 2002. Attrition in longitudinal population studies: does it affect the generalizability of the findings? *J. Clin. Epidemiol.* 55, 213-215.
- Degenhardt, L., O'loughlin, C., Swift, W., Romaniuk, H., Carlin, J., Coffey, C., Hall, W., Patton, G., 2013. The persistence of adolescent binge drinking into adulthood: findings from a 15-year prospective cohort study. *BMJ Open* 3, e003015.
- Edwards, A. C., Sihvola, E., Korhonen, T., Pulkkinen, L., Moilanen, I., Kaprio, J., Rose, R. J., Dick, D. M., 2011. Depressive symptoms and alcohol use are genetically and environmentally correlated across adolescence. *Behav. Genet.* 41, 476-87.
- Fergusson, D. M., Boden, J. M., Horwood, L. J., 2009. Tests of causal links between alcohol abuse or dependence and major depression. *Arch. Gen. Psychiatry* 66, 260-266.
- France, C., Lee, C., Powers, J., 2004. Correlates of depressive symptoms in a representative sample of young Australian women. *Aust. Psychol.* 39, 228-237.
- Glassman, T. J., 2010. Alcohol measures and terms: a perfect storm for chronic confusion. *J. Am. Coll. Health* 58, 397-399.
- Haynes, J. C., Farrell, M., Singleton, N., Meltzer, H., Araya, R., Lewis, G., Wiles, N. J., 2005. Alcohol consumption as a risk factor for anxiety and depression: results from the longitudinal follow-up of the National Psychiatric Morbidity Survey. *Br. J. Psychiatry* 187, 544-551.
- Hill, K. G., White, H. R., Chung, I. J., Hawkins, J. D., Catalano, R. F., 2000. Early adult outcomes of adolescent binge drinking: person- and variable-centered analyses of binge drinking trajectories. *Alcohol. Clin. Exp. Res.* 24, 892-901.
- Kessler, R. C., Wang, P. S., 2008. The descriptive epidemiology of commonly occurring mental disorders in the United States. *Annu. Rev. Public Health* 29, 115-129.
- Kizilbash, A. H., Vanderploeg, R. D., Curtiss, G., 2002. The effects of depression and anxiety on memory performance. *Arch. Clin. Neuropsychol.* 17, 57-67.

- Lee, A. E., Chokkanathan, S., 2008. Factor structure of the 10- item CES- D scale among community dwelling older adults in Singapore. *Int. J. Geriatr. Psychiatry* 23, 592-597.
- Lee, C., Dobson, A. J., Brown, W. J., Bryson, L., Byles, J., Warner-Smith, P., Young, A. F., 2005. Cohort profile: the Australian Longitudinal Study on Women's Health. *Int. J. Epidemiol.* 34, 987-91.
- Lee, K. J., Carlin, J. B., 2010. Multiple imputation for missing data: fully conditional specification versus multivariate normal imputation. *Am. J. Epidemiol.* 171, 624-632.
- Liu, S., Serdula, M. K., Byers, T., Williamson, D. F., Mokdad, A. H., Flanders, W. D., 1996. Reliability of alcohol intake as recalled from 10 years in the past. *Am. J. Epidemiol.* 143, 177-186.
- Longnecker, M. P., Newcomb, P. A., Mittendorf, R., Greenberg, E. R., Clapp, R. W., Bogdan, G., Willett, W. C. , Macmahon, B., 1992. The reliability of self-reported alcohol consumption in the remote past. *Epidemiology* 3, 535-539.
- Loxton, D., Schofield, M., Hussain, R., 2006. Psychological health in midlife among women who have ever lived with a violent partner or spouse. *J. Interperson. Violence* 21, 1092-1107.
- Manninen, L., Poikolainen, K., Vartiainen, E., Laatikainen, T., 2006. Heavy drinking occasions and depression. *Alcohol Alcohol.* 41, 293-299.
- Mchorney, C. A., Ware, J. E., Jr., Raczek, A. E., 1993. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med. Care.* 31, 247-63.
- Mchorney, C. A., Ware Jr, J. E., 1995. Construction and validation of an alternate form general mental health scale for the Medical Outcomes Study Short-Form 36-Item Health Survey. *Med. Care* 33, 15-28.

- Mcpherson, M., Casswell, S., Pledger, M., 2004. Gender convergence in alcohol consumption and related problems: issues and outcomes from comparisons of New Zealand survey data. *Addiction* 99, 738-748.
- Mealing, N. M., Banks, E., Jorm, L. R., Steel, D. G., Clements, M. S., Rogers, K. D., 2010. Investigation of relative risk estimates from studies of the same population with contrasting response rates and designs. *BMC Med. Res. Methodol.* 10, 26.
- Morton, S., Bandara, D. K., Robinson, E. M., Carr, P. E. A., 2012. In the 21st Century, what is an acceptable response rate? *Aust. N. Z. J. Public Health* 36, 106-108.
- Muthen, L. K., Muthen, B. O., 1998-2010. *Mplus User's Guide*. Sixth ed. Muthen & Muthen, Los Angeles, CA.
- National Centre for Social Research, 2009. *Adult Psychiatric Morbidity In England, 2007. Results Of A Household Survey*. London
- National Health and Medical Research Council, 2009. *Australian Alcohol Guidelines To Reduce Health Risks From Drinking Alcohol*. Commonwealth of Australia, Canberra.
- O'donnell, K., Wardle, J., Dantzer, C., Steptoe, A., 2006. Alcohol consumption and symptoms of depression in young adults from 20 countries. *J. Stud. Alcohol* 67, 837-840.
- Paljarvi, T., Koskenvuo, M., Poikolainen, K., Kauhanen, J., Sillanmaki, L., Makela, P., 2009. Binge drinking and depressive symptoms: a 5-year population-based cohort study. *Addiction* 104, 1168-1178.
- Pape, H., Norström, T., 2015. Associations between emotional distress and heavy drinking among young people: a longitudinal study. *Drug Alcohol Rev.* epub
- Patel, V., Flisher, A. J., Hetrick, S., McGorry, P., 2007. Mental health of young people: a global public-health challenge. *Lancet* 369, 1302-1313.

- Peele, S., Brodsky, A., 2000. Exploring psychological benefits associated with moderate alcohol use: a necessary corrective to assessments of drinking outcomes? *Drug Alcohol Depend.* 60, 221-247.
- Powers, J., Loxton, D., 2010. The impact of attrition in an 11-year prospective longitudinal study of younger women. *Ann. Epidemiol.* 20, 318-321.
- Powers, J. R., Anderson, A. E., Byles, J. E., Mishra, G., Loxton, D., 2015. Do women grow out of risky drinking? A prospective study of three cohorts of Australian women. *Drug Alcohol Rev.* 34, 278-288.
- Rich, J. L., Byrne, J. M., Curryer, C., Byles, J. E., Loxton, D., 2013. Prevalence and correlates of depression among Australian women: a systematic literature review, January 1999-January 2010. *BMC Res. Notes* 6, 424.
- Sas Institute Inc., 1999. *SAS/STAT User's Guide, Version 8*, SAS Institute Inc., Cary, NC.
- Silveira, E., Taft, C., Sundh, V., Waern, M., Palsson, S., Steen, B., 2005. Performance of the SF-36 Health Survey in screening for depressive and anxiety disorders in an elderly female Swedish population. *Qual. Life Res.* 14, 1263-1274.
- Theunissen, M. J., Jansen, M., Van Gestel, A., 2011. Are mental health and binge drinking associated in Dutch adolescents? Cross-sectional public health study. *BMC Res. Notes* 4, 100.
- Timko, C., Sutkowi, A., Pavao, J., Kimerling, R., 2008. Women's childhood and adult adverse experiences, mental health, and binge drinking: the California Women's Health Survey. *Subst. Abuse Treat. Prev. Policy* 3, 15.
- Tucker, J. S., Ellickson, P. L., Orlando, M., Martino, S. C., Klein, D. J., 2005. Substance use trajectories from early adolescence to emerging adulthood: a comparison of smoking, binge drinking, and marijuana use. *J. Drug Issues* 35, 307-332.

- Visser, P. S., Krosnick, J. A., Marquette, J., Curtin, M., 1996. Mail surveys for election forecasting? An evaluation of the Columbus Dispatch poll. *Public Opin. Q.* 60, 181-227.
- Wang, J. L., Patten, S. B., 2002. Prospective study of frequent heavy alcohol use and the risk of major depression in the Canadian general population. *Depress. Anxiety* 15, 42-45.
- Ware, J., Kosinski, M., Keller, S., 1994. SF-36 Physical and Mental Health Summary Scales: A User's Manual, The Health Institute, New England Medical Centre, Boston.
- World Health Organization, 2009. *Global Health Risks: Mortality And Burden Of Disease Attributable To Selected Major Risks*. WHO, Geneva.
- World Health Organization, 2010. *Global Strategy To Reduce The Harmful Use Of Alcohol*. WHO, Geneva.
- Young, A. F., Byles, J. E., Dobson, A. J., 1998. Women's satisfaction with general practice consultations. *Med. J. Aust.* 168, 386-389.
- Zeigler, D. W., Wang, C. C., Yoast, R. A., Dickinson, B. D., Mccaffree, M. A., Robinowitz, C. B., Sterling, M. L., 2005. The neurocognitive effects of alcohol on adolescents and college students. *Prev. Med.* 40, 23-32.

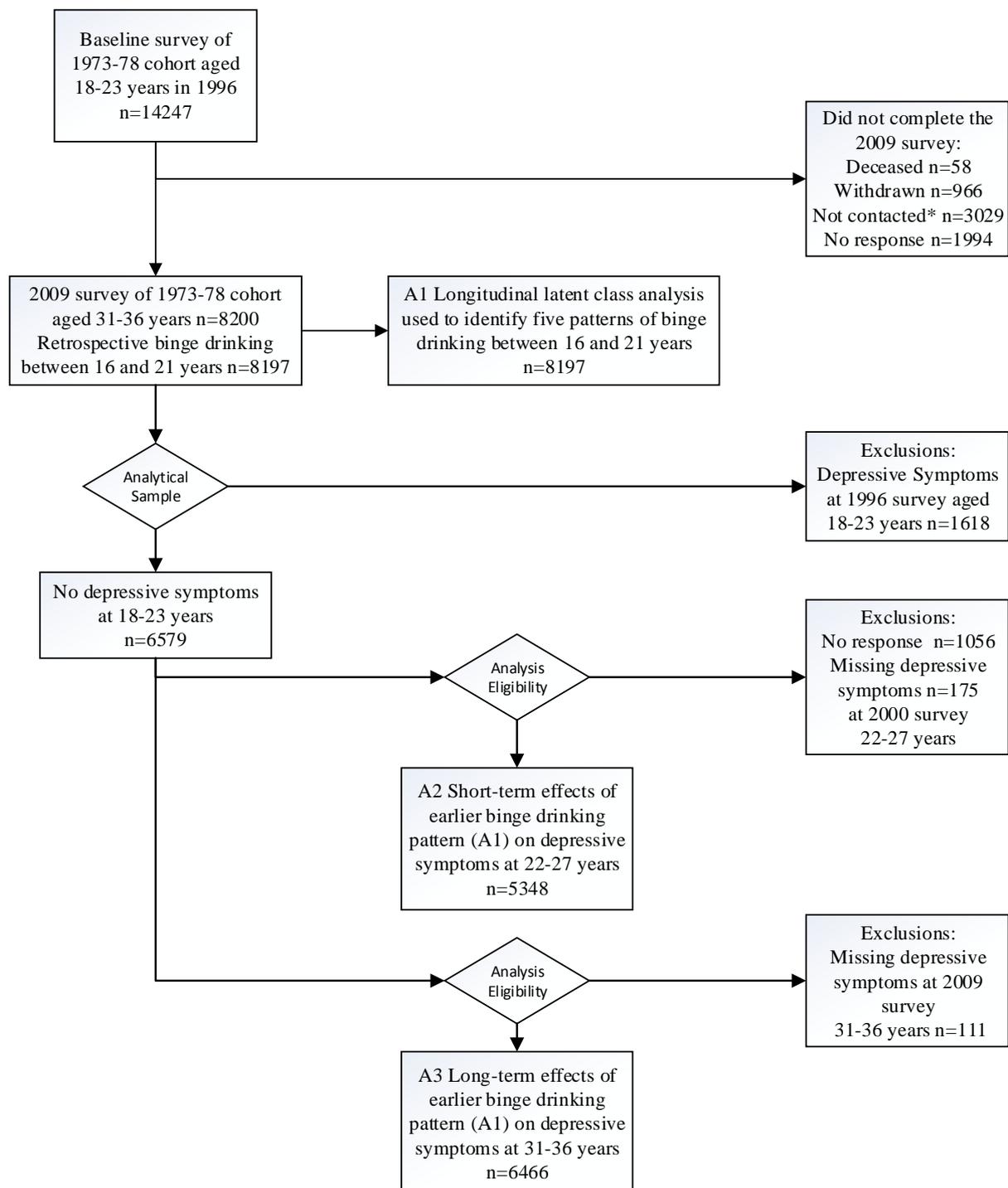
## Figure Captions

Figure 1. Flow chart for analyses of binge drinking patterns and their association with subsequent depressive symptoms in the 1973-78 cohort of the Australian Longitudinal Study on Women's health

Figure 2. Predicted proportions for 5 class longitudinal latent class model of binge drinking among 8197 women between 16 and 21 years of age

Class 1 were labelled as 'very infrequent bingers' and includes those women who never binged and where, over time, a small proportion went on to binge drink. Class 2 was labelled as 'fluctuating infrequent bingers' and comprised women who mainly binged rarely throughout the study period, and where the proportion who did binge more frequently than this fluctuated over time. Class 3 was labelled 'frequent bingers', where the proportion of women who binged increased over time until the majority were drinking on a monthly basis. Class 4 was labelled 'very frequent bingers', where the proportion of women who binged weekly increased from 7% at 16, until the majority were bingeing on a weekly basis. Class 5 was labelled 'extremely frequent bingers', where 21% were bingeing at least weekly at 16, with this proportion increasing until the majority were bingeing more than once a week.

Figure 1.



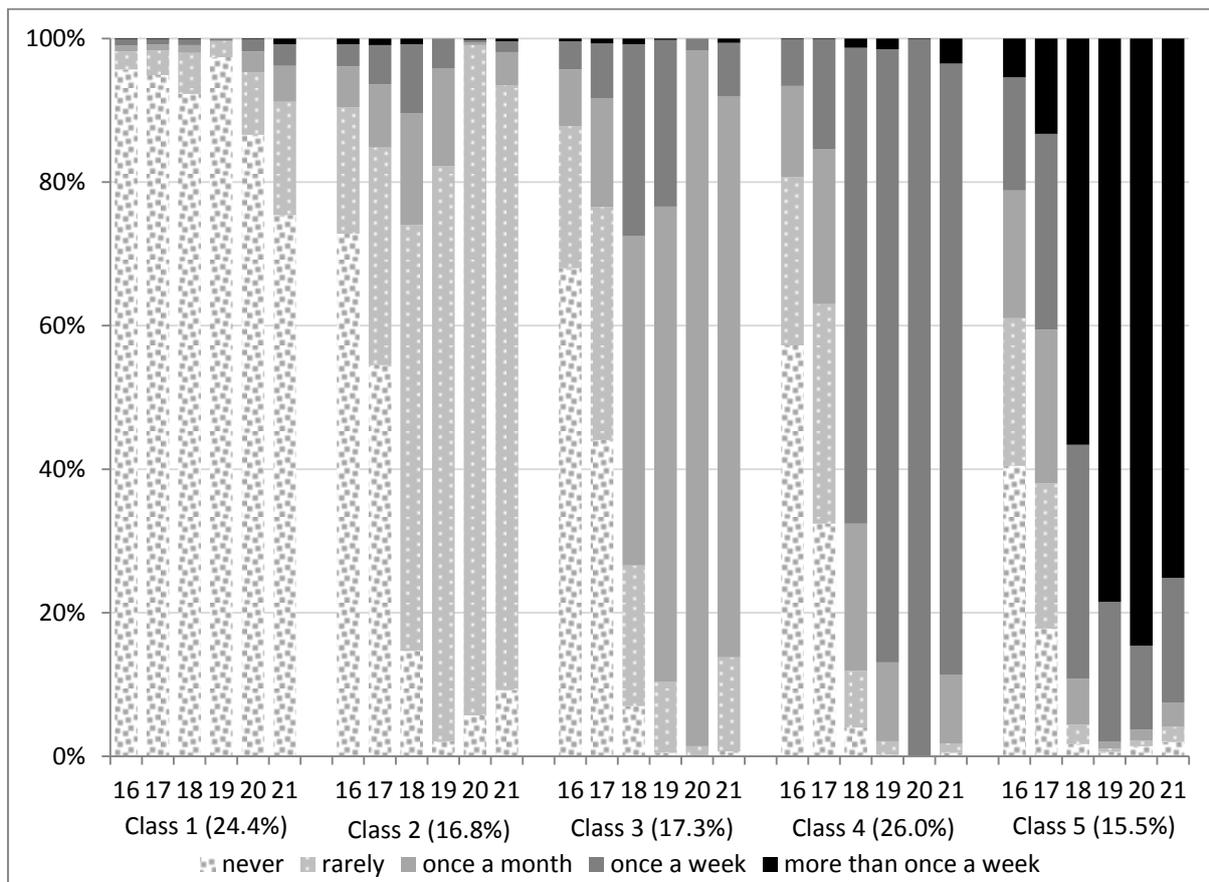
\* women could not be contacted despite every effort to locate them (Adamson and Chojenta, 2007)

A1 analysis 1

A2 analysis 2

A3 analysis 3

Figure 2.



## Tables

Table 1 Longitudinal latent class analysis fit statistics for different number of binge drinking trajectories (classes) using retrospective data from the 2009 survey of the 1973-78 cohort

	n = 8197					
	1 class	2 classes	3 classes	4 classes	5 classes	6 classes
- Loglikelihood	69635	57940	53103	49993	48104	47227
Number of parameters	24	49	74	99	124	149
Entropy	1.000	0.942	0.934	0.947	0.966	0.950
Bayesian information criterion sample size adjusted <sup>a</sup>	139409	116166	106637	100563	96931	95323
Lo-Mendell-Rubin adjusted likelihood ratio test (LMR)		23286	9632	6192	3760	1747
p-value <sup>b</sup>		<0.01	<0.01	<0.01	<0.01	0.74
Smallest class percentage*	100.0	40.9	24.9	15.7	15.7	10.0

<sup>a</sup> lowest value indicates best fit

<sup>b</sup> p<0.05 indicates significant improvement in fit with K classes versus K-1 classes

\* based on estimated posterior class membership probabilities.

Table 2. Characteristics of 8197 women in 1996 by different patterns of binge drinking between 16 and 21 years

Characteristics in 1996	Binge drinking patterns between 16 and 21 years*					
		Never	Rarely	Monthly	Weekly	More than weekly
	N	N=1998 %	N=1376 %	N=1417 %	N=2134 %	N=1272 %
Age group						
18-20 years	4334	49.1	51.4	53.1	55.8	55.1
21-23 years	3863	50.9	48.6	46.9	44.2	44.9
Urban						
Yes	4253	56.1	53.0	50.3	49.9	49.3
No	3944	43.9	47.0	49.7	50.1	50.7
Education						
Up to 12 years school	2322	28.4	29.4	25.6	27.2	32.4
Trade, certificate or diploma	1030	12.6	12.3	12.5	12.6	13.4
Non-tertiary, studying	3659	43.7	44.5	46.9	45.7	43.8
University	1142	15.2	13.9	15.1	14.6	10.4
Employed						
Yes	4344	51.3	51.4	54.1	57.2	54.0
No	3747	48.7	48.6	45.9	42.8	46.0
Monetary stress						
Yes	1970	18.1	21.9	22.1	26.6	33.5
No	6193	81.9	78.1	77.9	73.4	66.5
Relationship						
Married	694	13.8	11.0	7.6	4.3	5.2
De facto	988	8.1	16.4	11.6	12.9	12.3
Not partnered	6488	78.1	72.6	80.7	82.7	82.5
Children living with them						
Yes	454	7.3	9.8	4.0	2.6	4.3
No	7715	92.7	90.2	96.0	97.4	95.7
Experienced violence						
Yes	773	5.9	8.7	8.5	9.7	16.1
No	7383	94.1	91.3	91.5	90.3	83.9
Depressive symptoms <sup>a</sup>						
Yes	1611	19.9	18.6	17.3	18.2	25.3
No	6577	80.1	81.4	82.7	81.8	74.7

\* Binge drinking patterns identified using longitudinal latent class analysis. Data weighted for estimated probability of being in assigned class

<sup>a</sup> Mental Health Index score less than 53

Chi square tests were significant for each characteristic across binge drinking patterns ( $p < .01$ )

Missing data between 0% and 1.3%

Table 3. Odds of depression among 5348 women aged 22-27 years by earlier binge drinking

	Binge drinking pattern between 16 and 21 years				
	Never N=1334	Rarely N=944	Monthly N=965	Weekly N=1368	More than weekly N=737
% depressed <sup>a</sup>	20.7	21.3	20.6	20.5	30.6
Unadjusted OR	reference	1.04 (0.84;1.28)	0.99 (0.81;1.22)	0.99 (0.82;1.20)	1.70 (1.38;2.08)
Adjusted ORs					
OR adjusted for demographics		1.02 (0.82;1.26)	0.97 (0.78;1.21)	0.98 (0.81;1.20)	1.45 (1.17;1.81)
OR adjusted for demographics, relationships		1.04 (0.84;1.30)	0.96 (0.78;1.20)	0.96 (0.78;1.17)	1.39 (1.12;1.74)
OR adjusted for demographics, relationships, violence		1.02 (0.82;1.27)	0.94 (0.75;1.17)	0.93 (0.76;1.14)	1.30 (1.04;1.63)

Women with depressive symptoms at baseline (aged 18-23 years) were excluded

<sup>a</sup> 10 item Centre for Epidemiologic Studies Depression Scale score of 10 or more;  $p < 0.01$

Demographics include urban, age group, education, employed and monetary stress

Relationships includes relationship status and living with children

Data weighted for estimated probability of being in assigned class

OR Odds ratio

Missing data for final model 2.8%

Table 4. Odds of depression among 6466 women aged 31-36 years by earlier binge drinking

	Binge drinking pattern between 16 and 21 years				
	Never N=1569	Rarely N=1098	Monthly N=1147	Weekly N=1716	More than weekly N=936
% depressed <sup>a</sup>	17.5	17.1	16.2	17.6	22.1
Unadjusted OR	reference	0.97 (0.79;1.19)	0.91 (0.74;1.12)	1.01 (0.84;1.21)	1.34 (1.09;1.64)
Adjusted ORs					
OR adjusted for demographics		0.97 (0.78;1.20)	0.90 (0.73;1.12)	1.01 (0.83;1.22)	1.25 (1.01;1.54)
OR adjusted for demographics, relationships		1.01 (0.82;1.26)	0.94 (0.75;1.16)	1.03 (0.85;1.24)	1.23 (0.99;1.53)
OR adjusted for demographics, relationships, violence		0.99 (0.80;1.23)	0.92 (0.74;1.15)	1.01 (0.83;1.23)	1.19 (0.96;1.48)

Women with depressive symptoms at baseline (aged 18-23 years) were excluded

<sup>a</sup> 10 item Centre for Epidemiologic Studies Depression Scale score of 10 or more

Demographics includes urban, age group, education, employed and monetary stress

Relationships include relationship status and living with children.

Data weighted for estimated probability of being in assigned class

OR Odds ratio

Missing data for final model 1.0%