Is there really a 'J-shaped' curve in the association between alcohol consumption and symptoms of depression and anxiety? Findings from the Mater-University Study of Pregnancy and its outcomes.

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Abstract

Aims To determine the nature of the association between alcohol consumption and symptoms of anxiety and depression in women.

Design Prospective cohort study of women ($n = 4,527$) who received antenatal care at a major public hospital (Mater Misericordiae Hospital) in South Brisbane between 1981 and 1984 and who have follow-up data on alcohol use, depressive and anxiety symptoms over a 14-year period.

Findings At the 5-year follow-up there was a 'J' shaped association between alcohol consumption and both symptoms of depression and of anxiety. However, at the baseline assessment and the 14-year follow-up alcohol consumption was linearly and positively associated with depressive symptoms with increasing prevalence of symptoms with greater consumption. At the 5-year follow-up the prevalence of depressive and anxiety symptoms among those who were abstainers at both baseline and 5-year follow-up was similar to that among those who had been previous drinkers and then become abstainers ($P = 0.67$). Similarly, the prevalence of these symptoms was the same at the 14-year follow up comparing those who had been abstainers at baseline, 5-year and 14-year follow-up to those who had previously consumed alcohol but were then abstainers.

Conclusions The nature of the association between alcohol consumption and symptoms of depression and anxiety may vary across their life course in women. Previous drinkers who become abstainers do not appear to be at any higher risk of symptoms of depression or anxiety compared to those who always abstained, suggesting that increased symptoms in abstainers at age 30 is not due to 'sick-quitters'. The association of high alcohol consumption with symptoms of depression and anxiety may be confounded by low income and smoking.

Introduction

Affective and anxiety disorders are common causes of morbidity worldwide, and the chances of them co occurring with alcohol disorders are greater than expected by chance. (de Looper and Bhatia, 1999, World Health Organization, 2002, Henderson et al., 2000, Vaillant, 1995, Vaillant, 1983) Both clinical and population studies support the notion that individuals who consume alcohol at harmful levels are more likely to experience symptoms of anxiety and depression, although the causal direction associating these disorders is still a matter of debate (Caldwell et al., 2002b, Degenhardt and Hall, 2001, Degenhardt and Hall, 2003, World Health Organization, 2002).

In contrast, some recent evidence points to a J-shaped association between the full spectrum of alcohol use and these outcomes, (Degenhardt et al., 2001, Rodgers et al., 2000, Power et al., 1998) such that moderate drinking is associated with lower rates of depression and anxiety than are both high levels of consumption and abstinence. (Rodgers et al., 2000, Caldwell et al., 2002b, Degenhardt and Hall, 2001) While an increased risk of mental health disorders could be expected to be associated with heavy alcohol use, the apparent increased risk among abstainers compared to light or moderate drinkers raises a series of concerns for public health research and practice. Firstly, is the higher rate of mental ill-health for both those who abstain and those who consume large amounts of alcohol an early indicator of poor overall health? If so, are there similarities between this curvilinear association and the one between high risk of coronary heart disease and abstinence (Britton and Marmot, 2004, Corrao et al., 2000, Power et al., 1998)?

Secondly, could the j-shaped relationship between alcohol use and mental health be an 'artefact' or attributable to confounding? For example, some suggest that the presence of 'sick-quitters' (those who have experienced psychiatric disorders as a consequence of their level of alcohol consumption and as a result quit drinking) may account for higher rates of mental health problems in the abstinent group.(Goldman and Najman, 1984, Degenhardt and Hall, 2003) Alternatively, other factors may be associated both with abstinence and increased depression and may therefore confound the association.

Most evidence to date comes from cross-sectional studies, (Degenhardt and Hall, 2001, Degenhardt et al., 2000, de Looper and Bhatia, 1999, Rodgers et al., 2000) and, as such, cannot exclude the possibility that the increased risk in abstainers is due to 'sick quitters'. Longitudinal studies, which have repeated measures of both alcohol consumption and mental health status over time, have the capacity to identify abstainers with a previous history of heavy drinking. However, existing longitudinal studies have found conflicting results and have tended to rely on data from only two time points, frequently only covering a span of one or two years which may be insufficient to account for the effect of sick quitters. (Power et al., 1998, Vaillant, 1983, Vaillant, 1995, Sexton et al., 1999, Lipton, 1994, Roberts et al., 1995)

The study to date, which had the longest follow-up (10 years of follow-up between ages 23 and 33) found that, at age 33 alcohol consumption was non-linearly associated with a variety of health outcomes, including psychological distress as indicated by a high score on the Malaise Inventory.(Power et al., 1998) A 'J' shaped association was found with increased psychological distress among abstainers and

heavy drinkers compared to light or moderate drinkers. To determine whether the increased risk among abstainers might be due to 'sick-quitters' the investigators examined the relationship at age 33 among a restricted sample of participants in which those who were heavy or problem drinkers at age 23 were excluded. In this restricted sample the 'J' shaped association persisted leading the authors to conclude that abstinence may be a true predictor of poor mental health and that this association may be an early indicator of the later relationship between abstinence and mortality. (Power et al., 1998)

Understanding the aetiology of these mental health problems is clearly important in developing effective preventive strategies. Replication in other prospective studies is required to determine whether the above finding is robust. If a consistent 'J' shaped association, that is not due to confounding or sick-quitters is found in other prospective studies this would have important public health implications since it would suggest that mental health promotion should encourage light to moderate drinking, among the general population, in favour of abstinence or heavy drinking. In the British study, the sample's age spanned from 23 to 33 years of age. It would be interesting to assess whether the findings are limited to alcohol and mental health associations in youth or whether they apply to older age groups. Also, the instrument used to measure mental health (the Malaise Inventory) is a measure of general 'psychological distress', whereas it would be important to ascertain whether the association remains if depression and anxiety are assessed separately. Finally, a more direct way of assessing the role of sick-quitters would be valuable. For example, one could compare levels of depression and anxiety among those who have always been abstainers to those who have been previous drinkers and become abstainers. If the change from drinking to abstaining is associated with a greater level of mental health problems this supports the sick-quitter theory.

The aim of this study is to examine the association between alcohol consumption and symptoms of depressive and anxiety over a 14-year period in a prospective study of women from Brisbane, Australia. Specifically we aimed to determine whether we could explain any 'J' shaped association as being due to artefact (sick-quitting) or confounding. An inability to explain any 'J' shaped association as being due to either of these explanations would provide some evidence that, like cardiovascular disease, depression and anxiety may be elevated among abstainers compared to moderate drinkers via a causal mechanism.

Methods

Participants
The Mater-University study of pregnancy and its outcomes (MUSP) is a prospective study of women, and their offspring, who received antenatal care at a major public hospital (Mater Misericordiae Hospital) in South Brisbane between 1981 and 1984 (Keeping et al., 1989). The cohort consists of 7,223 women (and their offspring) who delivered a live singleton baby, who neither died nor was adopted prior to leaving hospital, and who completed both initial phases of data collection; this represents 87% of all women who attended the antenatal clinic during the study period.

These mothers and children have been followed-up prospectively with mothers completing questionnaires at their first antenatal clinic visit, 3-5 days after birth, 6

months after birth, 5 years and 14 years after birth. In this paper we are concerned only with the mothers and although alcohol consumption and depressive symptoms were assessed at all stages of the study, because pregnancy is likely to affect alcohol consumption and depressive symptoms, we have restricted our analyses to data concerned with the pre-pregnancy period (information provided by the mothers at their first antenatal visit on their level of alcohol consumption prior to becoming pregnant and their psychological assessment at that first antenatal visit) and obtained at the 5 and 14-year follow-up assessments.

Assessment of depression and anxiety
Depression and anxiety were assessed at all phases of the study using the Delusions-Symptoms-States Inventory (DSSI).(Bedford and Foulds, 1978) The DSSI items were administered to the mother in the form of a self-report questionnaire. The DSSI was developed by clinicians and validated against a clinical sample. (Bedford and Foulds, 1977) It contains a depression subscale which has been found to correlate strongly with other scales of depression including the Beck's Depression Inventory. (Najman et al., 2000) In this sample, the depression subscale obtained Cronbach's α values of .78 at the first clinic visit, .86 at 5-years follow-up, and .88 at 14-years follow-up, whereas the internal consistency of the anxiety subscale was .76 at first clinic visit, .83 at 5-years follow-up and .84 at 14-years follow-up. In this study in the main analyses maternal symptoms of depression was defined as having 3 or more out of the 7 of the symptoms in the DSSI depression subscale and symptoms of anxiety was similarly defined as having 3 or more out of 7 of the symptoms in the anxiety subscale. In order to ensure that the results were not driven by the choice of cut-off for defining a case, we also conducted sensitivity analyses in which all analyses were repeated with both outcomes defined by 2 or more, 4 or more and 5 or more symptoms.

Assessment of alcohol consumption
At each assessment the women were asked how frequently they consumed alcohol (six pre-specified categories from never to daily) and how much they consumed at each session (six pre-specified categories from none to seven or more standard drinks). These data were used to categorise the women into four categories that were similar to those used in the previous British prospective study: abstainers; light drinkers (>0 to 5 drinks per week); moderate drinkers (6-20 drinks per week) and heavy drinkers (greater than 20 drinks per week) (Power et al., 1998). Since the amount of alcohol in different drinks may vary between the two countries (for example draft beers may contain more alcohol in Australia than Britain) we also conducted a sensitivity analysis in which we defined light drinkers as >0 to 3 drinks per week, moderate drinkers as 4 to 15 drinks per week and heavy drinkers as greater than 15 drinkers per week.

Assessment of potential confounding factors
Parity (number of live births), obtained at the initial antenatal clinic visit was used to indicate number of children at all stages of assessment since this information was not collected at the 5- and 14-year follow-up. Maternal age was recorded at each assessment. Gross family income for the previous year was categorised as: low: <$10,400, middle: $10,400-$15,599 and high: $\geq$ $15,600 per annum, in the year of pregnancy; low: $\leq$ $AU 15,599, middle: $AU 15,600-$AU 25,999 and high $\geq$ $AU 26,000 per annum, at the 5-year follow-up; and low: $\leq$ $AU 25,999, middle: $AU 26,000-$AU36,499, and high: $\geq$ $AU 36,500 per annum at the 14-year follow-up.

Smoking at each assessment was categorised as none, 1-19 and 20 or more cigarettes per day. Marital status was obtained at each assessment and relationship difficulties (with the participant's spouse or partner) at each stage of the study was assessed using the Spanier Dyadic Adjustment Scale (DAS)(Spanier, 1976). The DAS aims to assess the quality of the relationship between married or cohabiting couples and categorises the women as having good partner relations, moderate conflict, major conflict or not in a relationship. The DAS has been used in Australia to assess marital satisfaction in different cohort studies. (Spanier, 1976, Vance et al., 1991) In this sample the scale achieved good reliability at all three phases (Cronbach's alpha of .86 at baseline and 5-year follow up and of .88 at 14-year follow up).

Statistical analyses

Cross sectional associations between alcohol consumption and depressive and anxiety symptoms were assessed at all three stages by presenting the age-adjusted prevalence of symptoms of depression and anxiety by categories of alcohol consumption estimated using logistic regression and inspecting the prevalence for each category of alcohol consumption in a graph. The possibility that any associations may be affected by 'sick-quitters' was assessed by using the data prospectively in two ways. Firstly, the associations at the 5- and 14-year follow-ups were assessed in restricted samples. For the 5-year follow-up we excluded from the analysis women who were heavy drinkers at the baseline assessment, whereas for the 14-year follow-up we excluded from the analyses women who were heavy drinkers at both the baseline and 5-year follow-up. The reasoning behind this approach, which is the way in which the previous British study used the prospective data to determine whether sick-quitting explained the association, is based on the idea that if the increase among abstainers seen in cross-sectional analyses is due to previous heavy drinkers becoming ill and then abstaining the exclusion of previous heavy drinkers from the analyses should result in a more linear association. Secondly, the prevalence of symptoms of depression and anxiety were compared between women who had always been abstainers and those who had previously been drinkers but were now abstainers at both follow-up phases. The presence of a 'J' shaped association was first assessed by examining graphs of the age-adjusted prevalence of each outcome for categories of alcohol consumption. Since the exposure data is an ordered categorical variable with just four categories rather than a continuous variable a quadratic (or higher power function) test of curvature in the association is not possible. We therefore used likelihood ratio tests to examine departure from a linear association. These tests compared a model in which the alcohol consumption variable was entered as three indicator variables with a model in which the variable was entered as a score. The likelihood ratio test for the difference between the two models provides a test of the null hypothesis that there is no difference between the models. A small p-value suggests that entering the data as categories (indicator variables) is a better way of describing the association between alcohol and the outcome and thus suggests that a non-linear association is a better description of the relationship than a linear association. The possibility that any associations were due to confounding was assessed by including potential confounding factors (age, parity, income, smoking, marital status and relationship difficulties) in a multivariable logistic regression model. All analyses were conducted using Stata version 8.0 (Stata inc, Texas).

Results

Of the 7,223 participants 4,527 (63%) had complete data on alcohol consumption and depressive and anxiety symptoms at all three time points. Women without complete data compared to those with complete data were more likely to have been heavy drinkers, depressed, anxious, heavy smokers, had lower income and symptoms of relationship conflict at baseline (Table 1). All further analyses are conducted only on the 4,527 women with complete data at all three phases of analysis.

The mean (standard deviation) age of the women included in the analyses was 25.0 (5.0) at the baseline assessment, 30.2 (5.1) at the 5-year follow up and 39.7 (5.2) at the 14-year follow-up. With the definitions we used, heavy drinking was rare among these women with just 2% at baseline and at the 14-year follow-up falling into the heavy drinking category and 1% at the 5-year follow-up being heavy drinkers. Between 20 and 25% of the women at each assessment were abstainers. Of the 4,527 women with complete data at all assessments 460 (10.2%) were abstainers at all three periods.

Table 2 shows the associations between alcohol consumption and symptoms of depression and anxiety at baseline and each of the two follow-up assessments in the full samples. At the 5-year follow-up there was a 'J' shaped association between alcohol consumption and both symptoms of depression and of anxiety. However, at the baseline assessment and the 14-year follow-up (mean age 39.7) there was a tendency for alcohol consumption to be linearly and positively associated with depressive symptoms such that the prevalence of symptoms increased with greater consumption, though the linear trend did not quite reach conventional levels of statistical significance at the 14-year follow-up. Symptoms of anxiety were linearly and positively associated with alcohol consumption at the baseline assessment but there was no association at the 14-year follow-up. There was no suggestion of increased prevalence of depressive or anxiety symptoms among abstainers compared to light drinkers at either the baseline or 14-year follow-up.

When these analyses were repeated among restricted samples – i.e. analyses in the 5-year follow-up restricted to those women who were not heavy drinkers at baseline (*n* =71 excluded) and analyses in the 14-year follow-up restricted to those women who were neither heavy drinkers at baseline or the 5-year follow-up (*n*=108 excluded), the results were essentially unchanged from those presented in table 2 and the 'J' shaped association between alcohol consumption and both outcomes at age 5 years remained. Only 21 women had changed from being moderate or heavy drinkers at baseline to abstainers at the 5-year follow-up and only 30 had changed from being either moderate or heavy drinkers at baseline or 5-year follow-up to being abstainers at the 14-year follow-up. We therefore compared the prevalence of depressive and anxiety symptoms among women who had ever previously drunk any amount but had then become abstainers to those who had always remained abstainers. Of the 982 abstainers at the 5-year follow-up 331 were previous drinkers and 651 had been abstainers at the baseline assessment. The age adjusted prevalence of depressive symptoms among those who were previous drinkers and then abstainers was 10.6% (95% CI: 7.1, 14.5) and that among those who were always abstainers was 11.4% (95% CI: 9.2, 14.1), p for difference in prevalence = 0.67. Of the 837 abstainers at the 14-year follow-up 377 were previous drinkers at either baseline or the 5-year follow-up and 460 had been abstainers at all three study phases. The age adjusted prevalence

of depressive symptoms among those who were previous drinkers and then abstainers at the 14-year follow-up was 11.4% (95% CI: 8.6, 15.1) and that among those who were always abstainers was 11.3% (95% CI: 8.7, 14.6), *P* for difference in prevalence = 0.96. Symptoms of anxiety were also similar between the two groups at both follow-up phases (both *P*-values >0.7).

Table 3 shows the associations of alcohol consumption with symptoms of depression and anxiety at all three stages with adjustment for potential confounding factors. These analyses are restricted to the 4,205 women with complete data on all covariates included in the models. Age-adjusted associations in this sample did not differ markedly from those presented for the larger sample assessed in table 2 suggesting that selection bias has not importantly affected the absence of covariates. Adjustment for income, smoking, marital status and relationship quality attenuated the associations between higher consumption and greater symptoms of depression and anxiety at the baseline assessment and between higher consumption and symptoms of depression at the 14-year follow-up. Most of this attenuation occurred with adjustment for family income and smoking with very little effect on any associations with adjustment for marital status and relationship quality. The increased odds of depressive and anxiety symptoms among abstainers at the 5-year follow-up was slightly increased by adjustment for these potential confounders. To determine whether the increased odds of depression or anxiety in abstainers compared to light drinkers at this age (mean 30.2 years) was related to increased psychological distress and reduced opportunities for socialising among those with large family commitments, we further adjusted these results for number of children. This adjustment attenuated the increased odds of depression among abstainers compared to light drinkers from 1.35 (fully adjusted odds ratio in Table 3) to 1.29 (95% CI: 1.01, 1.64) and the increased odds of anxiety among abstainers from 1.24 to 1.17 (0.99, 1.39). The addition of number of children to these models had little effect on the odds ratios for the associations of moderate or heavy drinking compared to light drinking compared to the fully adjusted models presented in table 3.

In sensitivity analyses using different thresholds to define symptoms of depression (2 or more, 4 or more and 5 or more symptoms) and to categorise alcohol intake (abstainers, >0-3, 4-15 or >15 drinks per week) none of the results were substantively different from those presented here.

Discussion
The aim of our study was to see if the previously reported J-shaped association between alcohol consumption and depressive and anxiety symptoms was robust in a prospective study or whether it could be explained by artefact (sick-quitting) or confounding.. Our findings suggest that the nature of the association between alcohol consumption and symptoms of depression and anxiety may vary by age in women, with a 'J' shaped association at mean age 30 but linear associations mean ages 25 and 40. The linear association we found at age 25 is consistent with existing cross-sectional evidence which has found a j-shaped relationship amongst Australian men, but not women who were aged 22-24 (Caldwell et al., 2002a). Our results do not support the increased prevalence of symptoms among abstainers compared to light drinkers at age 30 being due to 'sick-quitters' nor do they suggest that this association is due to confounding. However, it is noteworthy that the increased odds of depression among abstainers compared to light drinkers was 27% in age adjusted

models and 35% in full-adjusted models, whereas comparing heavy to light drinkers there was an approximate doubling of odds for depression (Table 3). Similarly, for anxiety symptoms the odds were considerably greater comparing heavy drinkers to light drinkers than abstainers to light drinkers. The association between higher levels of consumption and increased symptoms at all ages does appear to be confounded, particularly by family income and smoking.

Our results are consistent with previous studies which have also reported in crude or age adjusted analyses that women who drink at high levels are at increased risk of experiencing symptoms of depression, (Fillmore et al., 1998, Vaillant, 1995, Sexton et al., 1999, Roberts et al., 1995, Power et al., 1998, World Health Organization, 2002) and are also consistent with the previous prospective study among British women and men at age 33 which found an increased prevalence of psychological distress in abstainers in both sexes. (Power et al., 1998, Rodgers et al., 2000)

The difference in the nature of the association with different ages that we have found may be a chance finding or may represent a true variation in the relationship at different ages due to differences in the meaning of alcohol consumption for women at different stages in their life. The fact that the 'J' shaped association was consistent for both symptoms of depression and anxiety at age 30 reduces the likelihood that this is a chance finding, though does not exclude it. Interestingly the previous prospective study that reported a robust 'J' shaped association in both women and men was conduced when the women they were aged 33 years. It would be interesting to see whether continued follow-up of that study showed the same trend in the women who will now be aged 46. It is possible that symptoms of depression and anxiety related to alcohol consumption may vary across the life course (Vaillant, 1995). In this instance, abstinence in women aged 30 may represent an inability of the woman to socialise due to family and work pressures and these pressures and social isolation may result in the increased symptoms. Some evidence in support of this hypothesis comes from the fact that the increased odds of depression or anxiety symptoms among those who were abstainer compared to light drinkers attenuated with adjustment for number of children. At younger and older ages women may be either under less pressure from family commitments, particularly related to young children, or may have learnt coping strategies. However, this is speculative and further studies are required to determine whether there is a true variation in the nature of the association at different ages and to then explore the factors underlying this variation.

Results from this study should be interpreted in the context of some limitations. Our assessment of alcohol consumption does not accurately match current standardised screening measures, which include assessment of quantity, frequency and binge drinking over a specific time period. (National Health and Medical Research Council, 2001, Babor et al., 1992) However, we were able to categorise alcohol consumption into similar categories to those used by the longest prospective study to date (Power et al., 1998) and we also found that our findings were robust to changes in the thresholds used to define the different categories. The lack of use of a standard definition of alcohol consumption is unlikely to have influenced our main results and conclusions. Also, our findings may be biased by attrition. Women lost to follow up compared to those who remained in the study were more likely to have been heavy drinkers, depressed, anxious, heavy smokers, had lower income and symptoms of relationship conflict at baseline (Table 1). Our results would only be biased if the associations

were absent or in the opposite direction among non-respondents. That is to say our results would exaggerate the true association if heavy alcohol consumption was associated with reduced odds of depressive symptoms among non-respondents or not associated. Although we cannot assess this possibility, it is unlikely.

Very few of the women were heavy drinkers and therefore it is not surprising that the analyses in the restricted samples (with removal of previous heavy drinkers) did not differ markedly from analyses in the full sample. However, the prevalence of depressive or anxiety symptoms among women who had always been abstainers compared to those who had previously been drinkers (of any amount) and then abstainers was similar suggesting that among abstainers those who have changed from being previous drinkers are not more depressed or anxious. It is worth noting here that, ideally, we would need measures collected at short regular intervals, as alcohol consumption and symptoms of mental health problems vary over time in the general population. From this prospective, the MUSP study has limited capacity to assess change as our measurements are only available at irregular intervals (e.g. Prenatal, 5 and 14 years).

Ours is a study of women only and by definition, since women were recruited during their antenatal care, is a study of fertile women who have delivered at least one live child. The results we present are not necessarily generalisable to men and childless women. In particular the changing nature of the association between alcohol consumption and depressive and anxiety symptoms if replicated in other studies may be related to maternal family responsibilities and may not be the same in other groups.

Despite these limitations, this study has the strength, of being longitudinal in nature and one of the longest prospective studies to examine the relationship between alcohol consumption and symptoms of anxiety and depression over 14 years of the life of adult women, taking into account a number of important potential confounding factors. Our findings should then be seen as an important addition to the existing evidence on the subject.

In conclusion, our study shows that the relationship between alcohol consumption and symptoms of depression and anxiety may vary across different stages of the life course in women. Further, the association of increased symptoms of depression and anxiety among female heavy drinkers may largely reflect the impact of low income and smoking on both alcohol consumption and these symptoms. We suggest that further research is conducted to confirm these results.

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Table 1: Comparisons of baseline characteristics between those with complete data at all study phases and those without these complete data.

		Percentage		*P*-value
		Complete data *n*= **4527**	**Some missing data** *n* = **2696**	
Alcohol consumption	**Abstainer**	24.4	28.1	
	Light	67.0	60.6	
	Moderate	7.0	8.3	
	Heavy	1.6	3.1	< 0.001
Depression		9.4	15.5	< 0.001
Anxiety		21.3	30.4	< 0.001
Income	**Low**	29.0	43.4	
	Middle	59.0	47.9	
	High	12.1	8.7	< 0.001
Smoking	**None**	54.9	42.7	
	1-19 per day	27.6	33.5	
	≥ 20 per day	17.5	23.9	< 0.001
Partner Relationship	**Single**	3.3	6.2	
	Good	84.8	74.8	
	Moderate conflict	9.9	14.9	< 0.001
	Major conflict	2.1	4.1	

Table 2: Associations between alcohol consumption and symptoms of depression and anxiety at each of the 3 stages of the study

n = 4,527

	Baseline (Mean [SD] age = 25.0 (5.0)		5-year follow-up (Mean [SD] age = 30.2 (5.1))		14-year follow-up (Mean [SD] age = 39.7 (5.2))	
Depression						
	Number	Age-adjusted % (95% CI) with symptoms of depression	Number	Age-adjusted % (95% CI) with symptoms of depression	Number	Age-adjusted % (95% CI) with symptoms of depression
Abstainers	1104	8.1 (6.6, 9.9)	982	11.2 (9.3, 13.3)	837	11.3 (9.4, 13.7)
Light drinkers	3034	9.4 (8.4, 10.5)	3298	9.6 (8.7, 10.7)	3232	11.7 (10.7, 12.9)
Moderate drinkers	318	11.6 (8.5, 15.7)	210	14.1 (10.1, 19.5)	350	14.6 (11.2, 18.7)
Heavy drinkers	71	15.4 (8.7, 25.7)	37	19.1 (9.4, 35.0)	108	16.6 (10.7, 24.9)
P-value for linear trend		0.02		0.62		0.09
P-value for non-linear association		0.93		0.01		0.46
Anxiety						
	Number	Age-adjusted % (95% CI) with symptoms of anxiety	Number	Age-adjusted % (95% CI) with symptoms of anxiety	Number	Age-adjusted % (95% CI) with symptoms of anxiety
Abstainers	1104	20.0 (17.7, 22.5)	982	27.8 (25.0, 30.7)	837	29.4 (26.4, 32.6)
Light drinkers	3034	21.1 (19.7, 22.4)	3298	25.0 (23.5, 26.5)	3232	29.0 (27.4, 30.6)
Moderate drinkers	318	24.6 (20.1, 29.7)	210	31.4 (25.5, 38.0)	350	29.8 (25.2, 34.8)
Heavy drinkers	71	40.1 (32.6, 48.1)	37	43.5 (28.7, 59.6)	108	32.4 (24.3, 41.8)
P-value for linear trend		0.005		0.67		0.81
P-value for non linear association		0.17		0.002		0.67

Table 3: Multivariable associations between alcohol consumption and symptoms of depression and anxiety at each of the 3 stages of the study among those with complete data on all covariates *n* = 4,205

	Baseline (Mean [SD] age = 25.0 (5.0))		5-year follow-up (Mean [SD] age = 30.2 (5.1))		14-year follow-up (Mean [SD] age = 39.7 (5.2))	
	Depression					
	Age-adjusted OR (95% CI) of symptoms of depression	Fully-adjusted[a] OR (95% CI) of symptoms of depression	Age-adjusted OR (95% CI) of symptoms of depression	Fully-adjusted[a] OR (95% CI) of symptoms of depression	Age-adjusted OR (95% CI) of symptoms of depression	Fully-adjusted[a] OR (95% CI) of symptoms of depression
Abstainers	0.85 (0.65, 1.10)	0.88 (0.67, 1.15)	1.27 (1.01, 1.62)	1.35 (1.06, 1.72)	1.00 (0.95, 1.83)	1.00 (0.78, 1.29)
Light drinkers	1.00	1.00	1.00	1.00	1.00	1.00
Moderate drinkers	1.16 (0.78, 1.72)	0.91 (0.62, 1.37)	1.55 (1.01, 2.39)	1.42 (0.92, 2.20)	1.32 (0.95, 1.83)	1.30 (0.93, 1.80)
Heavy drinkers	1.39 (0.65, 2.97)	0.92 (0.42, 2.00)	2.52 (1.08, 5.85)	2.07 (0.89, 4.87)	1.43 (0.83, 2.47)	1.31 (0.75, 2.26)
P-value for linear trend	0.05	0.67	0.77	0.52	0.10	0.19
P-value for non-linear association	0.96	0.64	0.006	0.01	0.45	0.51

Table 3: continued

	Anxiety					
	Age-adjusted OR (95% CI) of symptoms of anxiety	Fully-adjusted[a] OR (95% CI) of symptoms of anxiety	Age-adjusted OR (95% CI) of symptoms of anxiety	Fully-adjusted[a] OR (95% CI) of symptoms of anxiety	Age-adjusted OR (95% CI) of symptoms of anxiety	Fully-adjusted[a] OR (95% CI) of symptoms of anxiety
Abstainers	0.92 (0.77, 1.10)	0.94 (0.78, 1.13)	1.19 (1.00, 1.40)	1.24 (1.04, 1.46)	1.05 (0.88, 1.25)	1.07 (0.90, 1.27)
Light drinkers	1.00	1.00	1.00	1.00	1.00	1.00
Moderate drinkers	1.17 (0.87, 1.56)	1.01 (0.75, 1.36)	1.44 (1.05, 1.97)	1.34 (0.98, 1.85)	1.07 (0.83, 1.37)	1.04 (0.81, 1.33)
Heavy drinkers	2.02 (1.18, 3.45)	1.59 (0.92, 2.76)	2.16 (1.08, 4.30)	1.85 (0.92. 3.71)	1.12 (0.73, 1.72)	1.02 (0.67, 1.57)
p-value for linear trend	0.01	0.18	0.83	0.62	0.88	0.72
p-value for non linear association	0.30	0.47	0.003	0.006	0.72	0.80

[a] Adjusted for family income, smoking, marital status and relationship quality