

# Association of adolescent symptoms of depression and anxiety with alcohol use disorders in young adulthood: findings from the Victorian Adolescent Health Cohort Study

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Anxiety and depression are the leading causes of burden of disease for young Australians aged 15–24 years, accounting for 17% of male and 32% of female disability-adjusted life-years.<sup>1</sup> Adolescent depression and anxiety are antecedents of a range of adverse life outcomes in young adulthood,<sup>2</sup> including substance use and abuse.<sup>3–5</sup>

Alcohol use disorders have become a common problem in young Australian adults and a major contributor to disease burden in young people aged 15–29 years.<sup>6</sup> Almost a third of young Australians report drinking at unsafe levels,<sup>1</sup> while almost 5% of young adults fulfil criteria for alcohol dependence set out in the *Diagnostic and statistical manual of mental disorders*, fourth edition,<sup>7</sup> with associated poor outcomes including alcohol-related injuries, antisocial behaviour and health risk behaviours.<sup>7</sup>

Many studies in recent decades have focused on the comorbidity between depression, anxiety and alcohol use disorders,<sup>8,9</sup> and its association with poor clinical course and outcomes, and greater social and personal impairment.<sup>4,9</sup> Yet the direction of association remains unclear. Prospective investigations attempting to disentangle causal pathways have been few and have yielded mixed findings.

Some studies have reported that early alcohol use disorders are predictive of young adult depression<sup>8</sup> and anxiety.<sup>10</sup> Whether a prospective association exists between adolescent depression and anxiety and the onset of alcohol use disorders in young adulthood is less clear. Although some studies have found a positive prospective association between adolescent depression, anxiety and alcohol use disorders,<sup>5,11,12</sup> others have reported a reciprocal relationship,<sup>13</sup> an association in a subgroup of males with conduct disorder only,<sup>5</sup> or no predictive relationship.<sup>14</sup> Such mixed findings preclude the development of clear prevention and intervention strategies.

Methodological limitations such as high and differential attrition of alcohol users, as well as low rates of alcohol use,<sup>11,14</sup> differences in study design and lack of statistical power, may account for some of these dis-

## ABSTRACT

**Objective:** To examine the association of adolescent depression and anxiety symptoms with alcohol abuse or dependence in young adulthood.

**Design, setting and participants:** Cohort study of the health and wellbeing of adolescents and young adults in Victoria, assessed at 8 waves (periods) of data collection, from age 14 to 24 years, between 1992 and 2003. Young people who participated in the cohort study at least once during the six adolescent assessment points (conducted 6 months apart, from age 14 to 17 years), at least once during young adulthood and who were alive at Wave 8 ( $n = 1758$ ).

**Main outcome measure:** Alcohol abuse or dependence assessed using the alcohol and substance abuse modules of the Composite International Diagnostic Interview at age 24 years.

**Results:** Adolescents with moderate to high levels of depression and anxiety symptoms (measured by the revised Clinical Interview Schedule) had an increased risk of alcohol abuse or dependence in young adulthood, compared with young adults with low levels of adolescent depression and anxiety symptoms, after adjusting for potential confounding factors. Risk was higher for those with symptoms at more than two adolescent assessment points (odds ratio [OR] 1.9; 95% CI, 1.7–2.0) and for those with symptoms at one or two assessment points (OR 1.3; 95% CI, 1.2–1.4), compared with those with no above-threshold symptoms in adolescence.

**Conclusions:** Adolescents with depression and anxiety symptoms are at increased risk for alcohol use disorders into young adulthood. They warrant vigilance from primary care providers in relation to alcohol use well into adulthood.

MJA 2011; 195: S27–S30

crepancies. Clarity is also needed in relation to the role that persistent symptoms of depression and anxiety across adolescence may play in the prediction of young adult alcohol use disorders.

Our study aimed to clarify the association between depression and anxiety symptoms in adolescence and alcohol use disorders in young adulthood, controlling for adolescent alcohol use, using data from a prospective population-based longitudinal study of adolescent and young adult health and wellbeing.

## METHODS

From 1992 to 2003, a cohort study of adolescent and young adult health was conducted in the state of Victoria, Australia. Data collection protocols were approved by The Royal Children's Hospital Ethics in Human Research Committee. At each wave, extensive data were collected on key adolescent and young adult mental and behavioural health issues, including psy-

chiatric morbidity and drug use (tobacco, alcohol, and illicit drugs). In Waves 1 to 6, participants self-administered the questionnaire on laptop computers,<sup>15</sup> with telephone follow-up of those absent from school. Data collection for Waves 7 and 8 was undertaken via computer-assisted telephone interviews.

## Sample and study design

The study design is shown in Box 1. The cohort was initially defined with a two-stage cluster sample in which two classes were selected at random from each of 44 secondary schools drawn from a stratified frame of all schools (government, Catholic and independent) in the state. School retention rates to Year 9 in the year of sampling were 98%. One class from each school entered the cohort in the latter part of the ninth school year (Wave 1), with the second class entering 6 months later, early in the 10th school year (Wave 2). There were six adolescent

### 1 Sampling and ascertainment in the Victorian Adolescent Health Cohort, 1992–2003

Phase	Adolescent					Young adult		
Survey Year	Wave 1 1992	Wave 2 1993	Wave 3 1993	Wave 4 1994	Wave 5 1994	Wave 6 1995	Wave 7 1998	Wave 8 2001–03
Mean age (years)	14.9	15.5	15.9	16.4	16.8	17.4	20.7	24.1
No. of participants	898	1727	1697	1628	1575	1530	1601	1520
Response rate	87%	85%	84%	80%	78%	75%	79%	75%
Design	2 entry points							
Ascertainment	Total intended sample = 1037 (Wave 1) + 995 (Wave 2) = 2032 96% (1943) of sample participated at least once in Waves 1–6							

assessment points (1992–1995), and two young adult assessment points (1998 and 2001–2003 respectively). Of the 1943 students (95.6%) who participated at least once during the adolescent waves, 1758 young people were alive at Wave 8, participated at least once in young adulthood and comprised the actual sample for the present study.

#### Measures

**Adolescent depression and anxiety.** Self-reported depression and anxiety symptoms were assessed in adolescence (Waves 1–6) using the computerised version of the revised Clinical Interview Schedule (CIS-R),<sup>16</sup> a structured, branched questionnaire, designed for assessing depression and anxiety symptoms in non-clinical populations. The total score for the CIS-R can range between 0 and 57, with a threshold of 12 or higher corresponding to a point at which a general practitioner would begin to be concerned about an individual's mental health.<sup>16</sup> A ternary exposure variable, representing number of waves (from Waves 2–6) of adolescent symptoms of depression and anxiety above the threshold (CIS-R total score > 11), was created to compare participants with low levels of symptoms (CIS-R total score ≤ 11 for Waves 2–6) with (i) those with above-threshold symptoms at one or two waves in adolescence, and (ii) those with above-threshold symptoms at more than two waves during adolescence.

**Young adult alcohol abuse or dependence.** Alcohol abuse or dependence in young adulthood (age 24 years) was assessed using the alcohol and substance abuse modules of the Composite International Diagnostic Interview (CIDI),<sup>17</sup> only for those participants who had consumed more than 11 standard drinks in the past 12 months. A binary variable was created, representing the presence or absence of alcohol abuse or dependence at age 24 years.

#### Potential confounding factors

- Demographic variables — obtained by participant self-report: sex, school location at study inception (metropolitan Melbourne v rural), participant country of birth (Australia v outside Australia), parental education (high school not completed/completed/tertiary education) and parental divorce or separation during the participant's adolescence.
- Adolescent alcohol use — defined from self-reported drinking (at least 11 drinks in the past 12 months) at each wave from Wave 2 to Wave 6. Retrospective diary data for these participants were used to calculate total units of alcohol drunk per week. The National Health and Medical Research Council (NHMRC) guidelines to reduce health risks from drinking alcohol<sup>18</sup> recommend that not drinking any alcohol is the safest option for those under 18 years of age, while adult men and women who consume more than two standard drinks on any day have an increased lifetime risk of harm from alcohol-related disease or injury. A three-level adolescent alcohol-use variable was created, representing (i) no alcohol consumption or drinking no more than two standard drinks per day at every wave from Wave 2 to Wave 6, (ii) one wave only of drinking more than two standard drinks per day at every wave from Wave 2 to Wave 6, and (iii) drinking more than two standard drinks per day at more than one wave from Wave 2 to Wave 6.
- Adolescent tobacco use — defined from self-reported smoking at each wave from Wave 2 to Wave 6. A variable representing number of waves of self-reported adolescent tobacco use, ranging from 0 to 5, was created.
- Parental alcohol and tobacco use — defined from participants' reports of whether their parents consumed alcohol and smoked most days or daily.

#### Statistical analysis

Missing data were handled using multiple imputation.<sup>19</sup> Data analysis was undertaken using Stata statistical software, version 11, 2009 (StataCorp, College Station, Tex, USA). Wave 1 data were not imputed as only half the participants were recruited into the cohort study at this stage. Instead, Wave 1 responses were used to fill in Wave 2 data for any participant not seen at Waves 2–6. Waves 2–8 were imputed only for participants who completed the survey at least once in adolescence (Waves 2–6) and at least once in young adulthood ( $n = 1760$ , including two who had died by Wave 8). The imputation model contained 23 key variables used in the analysis and 23 auxiliary variables considered helpful in informing the missing data. Auxiliary variables included participant's age, last year of secondary education, qualifications, current work status, whether the participant currently has a partner, whether the participant had ever had a baby, and variables from the adult waves (number of alcohol units, smoking status, nicotine dependence and depression). Of 46 variables included in the imputation model, 33% had <10% missing values, 30% had ≥ 10% to <15% missing values and 37% had ≥ 15% to <25% missing values. The adolescent depression and anxiety symptoms variable had 8% missing values at Wave 2 increasing monotonically to 17% missing at Wave 6. The alcohol abuse or dependence (age 24 years) measure had 14% missing values. Males and females were imputed separately. Twenty datasets were imputed using the Stata command "mi impute mvn" and combined using Rubin's rules.<sup>19</sup>

Analyses did not include data from the two participants who had died by Wave 8. The association between adolescent depression and anxiety symptoms and young adult alcohol abuse or dependence was examined using logistic regression. Only level of adolescent alcohol use was controlled for initially (Model 1), then adolescent alcohol use and other potential confounders were controlled for in Model 2. The interaction between adolescent depression and anxiety symptoms and level of adolescent alcohol use was tested in Models 1 and 2.

Separate analyses were performed to examine interactions between adolescent depression and anxiety symptoms and adolescent alcohol use. Odds ratios, adjusted for adolescent alcohol use in Model 1 and adjusted for adolescent alcohol use and

## 2 Association of adolescent symptoms of depression and anxiety (CIS-R\*) with alcohol abuse or dependence in young adulthood in 1758 adolescents followed to age 24 years

Adolescent depression and anxiety			Young adult alcohol abuse or dependence					
			Model 1 <sup>†</sup>			Model 2 <sup>‡</sup>		
CIS-R score > 11	No.	Proportion with alcohol abuse or dependence	OR	95% CI	P	OR	95% CI	P
0 waves	1020 (58%)	18%	1.0			1.0		
1–2 waves	439 (25%)	20%	1.1	0.8–1.6	0.47	1.3	1.2–1.4	<0.001
> 2 waves	299 (17%)	24%	1.4	1.0–2.0	0.06	1.9	1.7–2.0	<0.001

\* CIS-R = Revised Clinical Interview Schedule. † Adjusted for adolescent alcohol use. ‡ Adjusted for adolescent alcohol use, tobacco use, sex, school location, country of birth, parental education, marital status, parental tobacco and alcohol use. ◆

demographic factors in Model 2, were calculated using logistic regression.

### RESULTS

#### Prevalence estimates for alcohol use disorders

The estimated prevalence of alcohol use disorders at age 24 years was 27% (95% CI, 24%–30%) in males and 12% (95% CI, 10%–14%) in females, with an overall prevalence of 19% (95% CI, 17%–21%).

Overall rates of alcohol use disorder in young adulthood (age 24 years) were highest among teens reporting more than two waves of moderate to high adolescent symptoms of depression and anxiety (24%; 95% CI, 18%–29%), lower in those reporting one or two waves (20%; 95% CI, 16%–24%), and lower still in participants reporting few (18%; 95% CI, 15%–20%) adolescent symptoms of depression and anxiety (Box 2).

After adjusting for persistence of adolescent alcohol use (Model 1), the risk of young adult alcohol use disorders increased with the number of waves of above-threshold adolescent depression and anxiety symptoms, but did not reach statistical significance. With adjustment for further potential confounders, the risk of young adult alcohol abuse or dependence increased for those who had one or two, and more than two, waves of above-threshold adolescent depression and anxiety symptoms, compared with those with no waves of above-threshold adolescent depression and anxiety symptoms. The interaction between number of waves of above-threshold adolescent depression and anxiety symptoms and adolescent alcohol use was not statistically significant for Models 1 and 2, and was not retained.

### DISCUSSION

Adolescents with moderate to high levels of depression and anxiety symptoms had an increased risk of alcohol abuse or dependence in young adulthood, compared with young adults with low levels of adolescent depression and anxiety symptoms, after adjusting for potential confounding factors. Consistent with prior suggestions of a link between early depression and anxiety symptoms and later alcohol use disorders, our findings indicated an almost doubling of the risk of alcohol use disorders among adolescents with persistent depression and anxiety symptoms, after adjustment for relevant factors. Persistent depressive symptoms are common in adolescents and young adults, with recurrent depression associated with poorer psychosocial functioning<sup>20,21</sup> and higher rates of alcohol dependence;<sup>22</sup> however, most of the evidence for the latter has previously come from small, clinical samples. Our results are consistent with those of other studies<sup>5,11,12</sup> that also found a prospective association between adolescent depression, anxiety and alcohol use disorders. Other studies have reported a reciprocal relationship,<sup>13</sup> or no predictive relationship.<sup>14</sup> Our study differed in its use of alcohol use disorder diagnoses derived from structured interview, as well as in its more detailed assessment of adolescent psychopathology,<sup>13,14</sup> which are both possible explanations for the differences in findings.

Various interpretations of our findings are possible. These can be usefully considered using a developmental perspective. Adolescence is a time of increased risk for depression and anxiety symptoms, possibly due to changes in puberty, biological and/or psychological maturation and the challenges of gradually taking on adult roles.<sup>23</sup> Adolescents with a greater vulnerability to anxiety and depression may progress to alcohol

abuse or dependence in young adulthood as a result of self-medication for symptoms.

Psychosocial consequences of drinking may further contribute to the association. Depression and anxiety symptoms in adolescence, particularly if recurrent, may contribute to adversity and stressful life events and, consequently, to a greater likelihood of progression to alcohol abuse or dependence as a coping strategy in young adulthood. Social influences, such as peer groups, are also a possible explanation. Drinking peers may have a differential influence on young people with depression and anxiety symptoms, possibly as a result of social anxiety and fear of scrutiny.<sup>24</sup> Greater financial and social independence in young adulthood may facilitate both access to and use of alcohol to self-medicate symptoms.

Limitations of the present study include the use of self-report measures in the assessment of alcohol consumption. Moreover, the alcohol diary on which the weekly, and thus daily, alcohol units were based assessed actual volumes for the weekend and one weekday, with extrapolation to other weekdays. Although justified by individuals' limited recall capacity, some measurement error may have occurred. Further, there is the possibility that the CIDI overdiagnosed alcohol use disorders, thereby elevating prevalence estimates and rates of disorder. While a clinician evaluation was not used in the assessment of depression and anxiety symptoms, a measure with established reliability and validity was employed.<sup>16</sup> There is also the possibility of selection bias arising from the absence of early school-leavers from the sampling frame, who may have had high levels of both depression and anxiety symptoms and alcohol use. However, high response rates across waves, with low rates of absenteeism (<4%) should have minimised this source of error.

Strengths of our study include its prospective multiwave design, frequent assessment of depression and anxiety symptoms in adolescence, high participation rates, and controlling for potential confounding factors in analyses.

Our findings underscore the importance of vigilance around alcohol use in adolescents with persistent depression and anxiety symptoms. For this group, the risk period for drinking progression is likely to extend well beyond secondary school. Useful clinical strategies might include dealing with negative affect, and addressing possible misperceptions about the psychological benefits of drinking. Our findings highlight the importance of investing in mental health prevention and intervention programs in adolescence — which may reduce risk for alcohol abuse or dependence in teens with and without depression and anxiety symptoms. Secondary and tertiary intervention programs may also be needed for young adults with a history of adolescent depression and anxiety symptoms and alcohol use, who may be progressing towards alcohol abuse or dependence.

## ACKNOWLEDGEMENTS

We thank the Victorian Adolescent Health Cohort Study participants for their involvement. The study was funded by the NHMRC, the Australian Rotary Health Research Fund and the Victorian Health Promotion Foundation (Australia). Maria McKenzie is supported by an NHMRC Public Health PhD Scholarship, Anthony Jorm by an NHMRC Australia Fellowship, Craig Olsson by a Victorian Health Promotion Foundation (Australia) Research Fellowship and George Patton by an NHMRC Senior Principal Research Fellowship. We acknowledge the support of Australian Health Management in the preparation of this manuscript.

## COMPETING INTERESTS

None relevant to this article declared (ICMJE disclosure forms completed).

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(Received 30 Sep 2010, accepted 18 Apr 2011) □