Relation between age of first drinking and mental health and alcohol and drug disorders in adulthood:

Evidence from a 35 year cohort study

Running head: Consequences of early onset alcohol use

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Aims

This study estimated associations between AFD and: alcohol use disorder, nicotine dependence, cannabis dependence, illicit drug dependence, major depression, and anxiety disorder in adulthood, net of a series of covariate factors.

Design

Data were obtained from a longitudinal birth cohort.

Setting

Christchurch, New Zealand

Participants

The Christchurch Health Development Study (CHDS), a longitudinal study of a cohort born in 1977 and studied to age 35. Analysis samples ranged in size from 1056 (ages 11-13) to 962 (age 35).

Measurements

A measure of AFD (ages 5 to 13+ years) was generated using latent class analysis. Outcome measures included: major depression; anxiety disorders; alcohol use disorder, nicotine dependence, cannabis dependence, and other illicit drug dependence during the period 15 to 35 years. Covariate factors measured during childhood included family socioeconomic status, family functioning, parental alcohol-related attitudes/behaviours, and individual factors.

Findings

Earlier AFD was significantly (p < .05) associated with increased risk of alcohol use disorders, nicotine dependence, and illicit drug dependence, and was marginally (p < .10) associated with cannabis
dependence, but not depression or anxiety disorder. After controlling for covariate factors, the associations between age of first drinking and outcomes were no longer statistically significant (alcohol use disorder: B = -.07, 95% CI: -.22, .08; nicotine dependence: B = -.15, 95% CI: -.34, .04; illicit drug dependence: B = -.29, 95% CI: -.73, .15; cannabis dependence: B = -.05, 95% CI: -.31, .22).

Conclusions

The associations between AFD and later alcohol/drug disorders in adulthood were largely explained by covariate factors related to characteristics of the individual and family during childhood.
Introduction

Early alcohol use is hazardous to health and restrictions to age of first drinking (AFD) is a cornerstone of international policy (1, 2). Evidence has shown linkages between early AFD and subsequent adolescent drinking (3). Similarly alcohol use in childhood has been related to adolescent risk taking behaviors including: earlier unprotected sexual activity (4, 5), violent offending (6), unintentional self-injury (7) and illicit drug use (8). It is also clear that common environmental factors such as family context (9), parental use of alcohol and deviant peer affiliation (10) are significant correlates (11) of AFD.

The instability of alcohol diagnoses in adolescence suggests interventions at this age may help to alter the trajectory of alcohol use problems (12). This is potentially important as later alcohol dependence is considered to be a compulsive behaviour (13), implying greater difficulty in intervention. A further benefit may include reducing later mental health problems, given the linkages between early substance use disorders and later mental disorders (14). It is not clear, however, where this early intervention is best placed; public policy restricting alcohol use by age, in individual alcohol use intervention, family and social interventions, or elsewhere. Currently the first of these is a significant focus.

A number of studies have examined the linkages between AFD and later outcomes. For example, Guttmanova and colleagues (15), using longitudinal data, reported an association between earlier AFD and adult alcohol use disorder, even after controlling for socioeconomic status and other substance use disorders. Pederson and Skrondal (16) also used longitudinal data and found persistent linkages between AFD and both alcohol consumption and alcohol use disorders over a six year follow-up.

On the other hand, Prescott and Kendler (17)., using data from a twin study, found that the associations between AFD and later alcohol use disorder could be explained by genetic and shared environmental factors. Warner and White (9) used retrospective data and found that AFD was unrelated to later alcohol use in multivariate modeling.
There may be several reasons for the inconsistent findings concerning the associations between AFD and later outcomes (18). One reason is that studies have differed in the extent to which they controlled for possible sources of confounding and covariation. A second reason may be that while some studies have been retrospective in nature, others have reported prospectively-obtained data.

A further issue arising from the literature is that the outcome measures employed in studies of AFD have generally been limited to alcohol consumption and alcohol use disorder. Given the strong comorbidity between alcohol use disorders and other substance use disorders and internalizing disorders (19), examining the associations between AFD and a range of substance use and mental health disorders would provide information on the possible effects of AFD on later outcomes.

Against this background, this study examines data from a longitudinal birth cohort to investigate the linkages between AFD a range of outcomes measured from late adolescence to adulthood (ages 15 to 35 years), including: major depression; anxiety disorder; alcohol use disorder; nicotine dependence; cannabis dependence; and other illicit drug dependence. Because the assessment of AFD in the cohort was undertaken retrospectively across several assessment periods from ages 11-13, the study employed latent class modelling (20) procedures to estimate a more accurate measure of AFD. The aims of the study were to:

1. Estimate the bivariate associations between AFD and measures of: major depression; anxiety disorder; alcohol use disorder; nicotine dependence; cannabis dependence; and illicit drug dependence; during the period 15-35 years.

2. Adjust the associations between AFD and mental health and substance use outcomes for a series of covariate factors measured during childhood, including family socioeconomic status, family functioning, parental alcohol-related attitudes/behaviours, and individual factors.
**Methods**

**Participants**

The data were gathered during the course of the Christchurch Health and Development Study (CHDS). In this study a birth cohort of 1265 children (635 males, 630 females) born in the Christchurch (New Zealand) in mid-1977 has been studied at birth, 4 months, 1 year and annually to age 16 years, and again at ages 18, 21, 25, 30 and 35 years (21, 22). All study information was collected on the basis of signed consent from study participants and all information is fully confidential. All aspects of the study have been approved by the Canterbury (NZ) Ethics Committee.

**Age of first drinking (AFD)**

At ages 11, 12 and 13 years, cohort members were asked to report the age at which they first recalled drinking alcohol. Also from age 11, cohort members and their parents were asked whether the cohort member had drunk alcohol in the past year. Using these data it was possible to classify the reported age of first alcohol consumption into the following class intervals: a) 0-5 years; b) 6-10 years; c) 11-12 years; and d) after the age of 13 years. The latent class model fitted the observed data well ($X^2$ (663) = 156.49, $p = 1.00$) and assignment of cohort members to latent classes on the basis of observed report data resulted in an estimated 86.1% of the sample being correctly classified, and an entropy estimate of .724. As the probability of correct assignment to class was high, correction for possible mis-assignment was not used.

Further information on this measure is available in the Online Supplement.
Major depression and anxiety disorder (15-35 years)

Cohort members completed the Diagnostic Interview Schedule for Children (DISC: 23) at age 16 years, and the Composite International Diagnostic Interview (CIDI: 24) at ages 18, 21, 25, 30 and 35 years. These data were used to classify individuals as to whether they met DSM-IV (25) criteria for major depression and anxiety disorder over the intervals 15-18 years, 18-21 years, 21-25 years, 25-30 years, and 30-35 years. Further information on this measure is available in the Online Supplement.

Substance use disorders (15-35 years)

Also at ages 16, 18, 21, 25, 30 and 35 years cohort members were questioned about their substance use behaviors and problems associated with substance use since the previous assessment (alcohol, tobacco, cannabis, other illicit drugs), based on the CIDI (items for cigarette smoking were custom written). Using this information cohort members were classified as meeting DSM-IV criteria for alcohol use disorders (dependence or abuse), nicotine dependence, cannabis dependence and other illicit drug dependence over the intervals 15-18 years, 18-21 years, 21-25 years, 25-30 years, and 30-35 years. Further information on these measures is available in the Online Supplement.

Covariate factors

A number of covariate factors were chosen for inclusion in the analysis, on the basis that they were: a) used in a prior analysis of the age of first alcohol use in the CHDS cohort (26); or b) have been found to be related to substance use outcomes in other studies of the CHDS cohort (27-32). These included:

Measures of family socio-economic and demographic background
Maternal age. Assessed at the time of the survey child’s birth.

Family living standards (0-10 years). At each year a global assessment of the material living standards of the family was obtained by means of an interviewer rating.

Maternal and paternal education. Parental education level was assessed at the time of the survey child’s birth reflecting the highest level of educational achievement attained.

Family socioeconomic status (SES). Family SES was assessed at the time of the survey child’s birth using the Elley-Irving (33) scale of socio-economic status for New Zealand.

Single parenthood at birth. Family structure was assessed at the time of the survey child’s birth.

Average family income (0–10 years). At each year, estimates of the family’s gross annual income were obtained from parental report and were recoded into decile categories.

Maori ethnicity (at birth). Maori ethnicity was assessed at the time of the cohort member’s birth.

Individual, personality and behavioural factors

Gender. Recorded at birth.

Child conduct problems (7–9 years). When sample members were aged 7–9 years, information on child behaviour problems was obtained from parental and teacher report using a behaviour questionnaire combining items from the Rutter et al. (34) and Conners (35) parental questionnaires. (α = .97).
Neuroticism (age 14). This was assessed using a short form version of neuroticism scale of the Eysenck Personality Inventory (36) at age 14. (α = .80).

Novelty-seeking (age 16). Novelty-seeking was assessed at age 16 using the novelty seeking items from the Tridimensional Personality Questionnaire (37), (α =0.76).

Family functioning, parental behaviour and abuse exposure measures

Parental illicit drug use (0–11 years). At age 11, parents were questioned regarding their history of illicit drug use. The young person was classified as having a parent history of illicit drug use if one of his/her parents was reported to have a history of illicit drug use.

Parental alcohol problems (0–15 years). This was assessed at age 15 years via parental report. These reports were used to form a dichotomous measure of whether or not the young person’s parents reported experiencing problems with alcohol.

Parental criminality (0–15 years). At age 15 years, parents were questioned as to whether any parent had a history of criminal offending. The young person was classified as having a parent history of criminality if one of his/her parents was reported to have a history of offending.

Parental alcohol consumption. At age 11, parents were asked how many alcoholic drinks they would normally consume in a week and how many they had consumed in the past week. These measures were combined to form a measure of the parents’ typical weekly alcohol consumption.

Parental approval of adolescent drinking. At age 15 years, teenagers were asked to describe their parent’s views about adolescent alcohol consumption on a 5-point scale ranging from strongly opposed to unconcerned.
Parental attitudes to alcohol use. At age 15 years, the young people were asked to rate their parents attitudes to alcohol use in general on six 3-point scales reflecting both their parent's use of alcohol and attitudes to alcohol use.

Changes of parents (to age 15 years). At each assessment from birth to 15 years, information was gathered on changes in the child’s family situation since the previous assessment. Using this information an overall measure of family instability was constructed up to age 15.

Parental attachment (age 15). This was assessed using the parental attachment scale developed by Armsden and Greenberg (38) and administered when sample members were aged 15. The full parental attachment scale was used in this analysis and was found to have good reliability (α = 0.87).

Exposure to harsh/abusive physical punishment (childhood physical abuse; 0–16 years). At ages 18 and 21 sample members were asked to describe the extent to which their parents used physical punishment during childhood (39). This information was used to create a four-level scale reflecting the most severe form of physical punishment reported for either parent.

Childhood sexual abuse (0-16 years). At ages 18 and 21 years sample members were questioned about their experience of sexual abuse during childhood (<16 years) (40). Questioning spanned an array of abusive experiences from episodes involving non-contact abuse (e.g. indecent exposure) to episodes involving attempted or completed intercourse. A 4-level scale was devised reflecting the most extreme form of sexual abuse reported by the young person at either age.

Inter-parental violence (0–16 years). At age 18, sample members were questioned concerning their experience of inter-parental violence during their childhood (prior to age 17 years). The questioning was based on a series of eight items derived from the Conflict Tactics Scale (41).

Details of all measures are provided in greater detail in the Online Supplement.
Statistical Analysis

The unadjusted associations between the latent class measure of age of onset of drinking and the repeated measures of mental health and substance use outcomes at ages 15-35 were tested for statistical significance by fitting a population-averaged generalised estimating equation (GEE) model to the data for each outcome. GEE models are appropriate for use in the analysis of repeated measures longitudinal data (42, 43).

In order to adjust the models for the possible influence of a range of covariate factors, the GEE models were extended to include the measures of potential covariate factors noted above. This procedure was undertaken twice; first with the full set of covariate factors, and again using only those covariate factors that were found to be statistically significant (p < .05) in the analysis.

Details of model specification are provided in the Online Supplement.

Sample Size

The present analysis is based upon the sample having: a) an estimate of latent class assignment for AFD; and b) data on the outcome measures at each age. These samples ranged in size from 1056 (latent class measure of AFD) to 962 at age 35, representing between 76% to 83.5% of the initial cohort of 1265 children.

Results

Associations between AFD and mental health and substance use disorders (ages 15-35)
Table 1 shows the bivariate associations between the latent class measure of AFD and mental health and substance use disorders, pooled over the assessment periods. The Table shows the percent meeting DSM criteria for each disorder during each assessment period, and the population-averaged rate for each disorder over the five assessment periods. The test of significance for each outcome was obtained via logistic GEE models, fitted to the repeated measures data and pooled over the five assessment periods (15-18; 18-21; 21-25; 25-30; 30-35 years). The table shows that alcohol use disorders, nicotine dependence and other illicit substance dependence over the period 15–35 years were all associated significantly (P < 0.05) with AFD. In all cases, lower AFD was associated with higher rates of substance use disorder. Neither major depression nor anxiety disorder were found to be associated with AFD at the bivariate level, and were dropped from further analyses at this point.

INSERT TABLE 1 HERE

**Associations between covariate factors and: a) AFD; and b) outcome measures**

It could be argued that the associations between earlier AFD and increased risk of substance use disorder outcomes shown in Table 1 reflect the influence of covariate factors that may influence both AFD and substance use disorders later in life. In order to examine this issue, a series of socio-demographic, individual and family factors were abstracted from the study database. Table 2 shows estimates of the Pearson product-moment correlations between these factors and both: a) AFD; and b) the four substance use disorder outcomes shown in Table 1. The Table shows that each of the covariate factors was significantly (p < .05) correlated with at least one of the predictor or outcome measures. These findings suggest the possibility that the associations between age of first drinking and substance use disorder outcomes shown in Table 1 may have arisen due to the influence of covariate factors.
**Associations between AFD and substance use disorders (ages 15-35), after adjustment for covariate factors**

In order to account for the influence of potential covariate factors, the GEE models of the associations between AFD and the substance use disorders shown in Table 1 were extended to include the set of covariate factors shown in Table 2 to arrive at stable and parsimonious models. The results of this model fitting are shown in Table 3, which shows estimates of the associations between AFD and outcomes both: a) after entering all covariates into the model; and b) controlling for only statistically significant (p < .05) covariate factors. Inspection of the Table shows that both modelling procedures produced largely similar results.

The results in Table 3 show that, after adjustment for covariate factors, AFD was no longer significantly associated with any of the four substance use disorder outcomes. Across the four substance use disorder outcomes, statistically significant (p < .05) covariate factors included: maternal education level; average family living standards; SES at birth; Maori ethnicity; gender; conduct problems; neuroticism; novelty-seeking; parental offending; and childhood sexual abuse. The results of this modelling suggested that the apparent increase in risk of later substance use disorders amongst those initiating alcohol consumption at an earlier age could be accounted for by a series of factors that increased the risk of both: a) AFD; and b) later substance use disorders.
Discussion

The present study examined the association between age of first drinking (AFD) and adult (ages 18-35) mental health, alcohol, tobacco and drug use disorders, using data from a longitudinal birth cohort. Because the assessment of AFD occurred across several assessments from ages 11 to 13, methods of latent class analysis (20) were used to estimate a more accurate measure of AFD. The results of these analyses suggested the following conclusions. First, the bivariate associations between AFD and outcomes suggested that younger AFD was associated significantly with increased risk of alcohol use disorder, nicotine dependence and other illicit drug dependence. However, adjustment for a series of covariate factors, measured in childhood, that were shown to be related either to AFD or to mental health and substance use disorders in adulthood, reduced the magnitude of the associations between AFD and later substance use disorders to statistical non-significance. These results suggested that the apparent associations between AFD and later mental health and substance use disorders could be explained by covariate factors that increased the risk of both earlier AFD and later substance use disorders.

The literature has been divided about the importance of AFD and later mental health and behavioral problems. A recent systematic review identified five cohort studies in general populations that examined the link between AFD and later alcohol problems (18). This review found meage and inconsistent evidence of a causal association. The authors note the diminished impact of AFD in the cohorts with better control of covariates. Our study supports and extends these findings. The latent classes developed for this study minimizes the risk of recall bias, and a significantly greater number of potential covariate factors were able to be accounted for in our study compared to other cohorts. Importantly, no previous cohort study has included individual personality factors as potential covariate
despite the strong evidence early personality is causally related to later mental health and addictions problems (14).

It should be noted that the findings of the present analysis differ somewhat from an earlier analysis of data from the present cohort (3). In that study, earlier AFD was associated with increased risk of frequent, heavy or problem drinking at age 15 years, even after controlling for covariate factors. Taken together, the findings of the earlier study and the present findings suggest that although earlier AFD drinking was linked to problematic drinking behaviours in mid-adolescence, these problem drinking behaviours did not translate into increased risk of alcohol use disorder or other substance use disorders into adulthood. This pattern of findings implies that the impacts of AFD are relatively short-term, and that long-term issues with alcohol and drug dependence are more likely to be caused by a range of adverse personal, environmental and social factors to which an individual may be exposed earlier in life.

Although AFD appears to be an intuitively sensible target to minimize the later harms of alcohol, the results of the present study suggest that attempting to delay AFD to later ages is unlikely to have significant impact on the risk of substance use disorders later in life. The findings of the present study indicate that Individual factors related to family socioeconomic status, family functioning, personality and behavioural characteristics, and exposure to trauma are more likely to play a causal role in later substance use disorders than AFD. Public health measures aimed at strengthening families, reducing trauma towards children, reducing the incidence of conduct problems, and improving economic equality across society may also have a more positive impact on later substance use outcomes than public health campaigns targeting early drinking behavior. Furthermore, medical practitioners and policy makers are more likely to make positive changes in reducing substance use disorder by developing policies and interventions aimed at addressing problematic patterns alcohol use by young people, for which there is
considerable evidence of causal linkages to alcohol and other substance use disorders in adulthood (44, 45).

As with any study this paper is limited by the confines of the research. Although comprehensive in its assessment of possible covariates it is not possible to be certain all potential factors have been taken into account. In addition, although the time frame for the assessment of covariate factors was clear, it is likely that the temporal relationship between the effects of covariate factors and AFD is not entirely clear. Further research is needed to better understand the temporal relationship between covariate factors and AFD, and later substance use disorders. It is also worth noting this study was limited to examining the association of AFD and later alcohol and drug use disorder, omitting other health and social outcomes that may also have some link to AFD. Additional research is needed to examine possible linkages between adult psychosocial and physical health problems and AFD.
References


Table 1. Associations between age of onset of alcohol use and mental health and substance use outcomes (ages 15-35)

<table>
<thead>
<tr>
<th>Outcome (%)</th>
<th>Age</th>
<th>Latent class measure of age of onset of alcohol use</th>
<th>1-5 years</th>
<th>6-10 years</th>
<th>11-12 years</th>
<th>13+ years</th>
<th>p₁</th>
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<tr>
<td>15-18 years</td>
<td>27.3</td>
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<td>26.0</td>
<td>23.2</td>
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<tr>
<td>18-21 years</td>
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<td>28.7</td>
<td>18.9</td>
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<tr>
<td>21-25 years</td>
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<td>21.5</td>
<td>24.0</td>
<td>17.9</td>
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<td>25-30 years</td>
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<td>20.0</td>
<td>23.9</td>
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<td>30-35 years</td>
<td>19.5</td>
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<td>16.9</td>
<td>22.1</td>
<td></td>
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<tr>
<td>Population-averaged %</td>
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<td>21.2</td>
<td>23.2</td>
<td>21.1</td>
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<td>28.1</td>
<td>32.5</td>
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<td>17.4</td>
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<td>14.3</td>
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<td>18.6</td>
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<td>20.1</td>
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<td>24.6</td>
<td>16.8</td>
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Parameter estimate and test of significance

- Major depression: B = -.01, 95% CI: -.14, .12, p > .90
- Anxiety disorders: B = -.06, 95% CI: -.20, .08, p > .30
- Alcohol use disorder: B = -.23, 95% CI: -.37, -.09, p < .001
- Nicotine dependence
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<th>Cannabis Dependence</th>
<th>Other Illicit Drug Dependence</th>
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<td>Parameter estimate and test of significance</td>
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<td>B = -.26, 95% CI: -.44, -.08</td>
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<td>25-30 years</td>
<td>19.7</td>
<td>B = -.22, 95% CI: -.47, .04</td>
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<tr>
<td>30-35 years</td>
<td>20.0</td>
<td>B = -.36, 95% CI: -.58, -1.15</td>
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Table 2. Pearson product-moment correlations between covariate factors and a) age of onset of alcohol use; and b) substance use outcomes (ages 15-35)

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<th>Covariates</th>
<th>Latent class age onset of alcohol use</th>
<th>Alcohol use disorders</th>
<th>Nicotine dependence</th>
<th>Cannabis dependence</th>
<th>Other illicit drug dependence</th>
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<td>Maternal age</td>
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<td>-.05</td>
<td>-.14***</td>
<td>-.05</td>
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<td>.00</td>
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<td>-.11***</td>
<td>-.04</td>
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<td>-.08*</td>
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<td>Average family income (0-10 years)</td>
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<td>.12***</td>
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<td>Māori ethnicity</td>
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<td>.13***</td>
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<td>.01</td>
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<td><strong>Individual, behavioural and personality factors</strong></td>
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<td>-.03</td>
<td>-.18***</td>
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<td>Child conduct problems (7-9 years)</td>
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<td>.22***</td>
<td>.17***</td>
<td>.09**</td>
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<td>.01</td>
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<td>Novelty-seeking (age 16)</td>
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<td>.27***</td>
<td>.24***</td>
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<td><strong>Family functioning, parental and abuse exposure measures</strong></td>
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<tr>
<td>Parental illicit drug use (0-11 years)</td>
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<td>.07*</td>
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<td>Parental alcohol problems (0-15 years)</td>
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<td>.15***</td>
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<td>.08*</td>
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<td>Parental criminal offending (0-15 years)</td>
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<td>.10**</td>
<td>.19***</td>
<td>.15***</td>
<td>.08*</td>
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<td>Parental alcohol consumption (age 11)</td>
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<td>-.02</td>
<td>-.00</td>
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<td>-.01</td>
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<td>variable</td>
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<td>.04</td>
<td>.06</td>
<td>.02</td>
<td>-.01</td>
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<td>Parental approval of adolescent drinking (age 15)</td>
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<td>Parental attitude to alcohol use (age 15)</td>
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<td>.09**</td>
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<td>Changes of parents (0-15 years)</td>
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<td>.12***</td>
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<td>Parental attachment (age 15)</td>
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<tr>
<td>Childhood physical abuse (0-16 years)</td>
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<td>.15***</td>
<td>.12***</td>
<td>.14***</td>
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<td>Childhood sexual abuse (0-16 years)</td>
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<td>.19***</td>
<td>.14***</td>
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<td>Inter-parental violence (0-16 years)</td>
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<td>.15***</td>
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<td>.14***</td>
<td>.13***</td>
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*p<.05  
**p<.01  
***p<.001
Table 3. Associations between age of onset of alcohol use and substance use disorder outcomes (ages 15-35), adjusting for: a) all covariates; and b) only statistically significant (p < .05) covariates.

<table>
<thead>
<tr>
<th>Outcome (ages 15-35 years)</th>
<th>Adjusting for all covariates</th>
<th>Adjusting for only statistically significant covariates</th>
<th>Statistically significant (p&lt;.05) covariates</th>
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<tbody>
<tr>
<td></td>
<td>B</td>
<td>95% CI</td>
<td>p</td>
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<tr>
<td>Alcohol use disorder</td>
<td>-.08</td>
<td>-.24, .08</td>
<td>&gt;.30</td>
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<td>Nicotine dependence</td>
<td>-.10</td>
<td>-.31, .10</td>
<td>&gt;.30</td>
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<td>Cannabis dependence</td>
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<td>-.35, .25</td>
<td>&gt;.60</td>
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<tr>
<td>Other illicit drug dependence</td>
<td>-.27</td>
<td>-.76, 13</td>
<td>&gt;.10</td>
</tr>
</tbody>
</table>

Covariates:

1 = Maternal education level

2 = Average family living standards (ages 0-10)

3 = SES (at birth)

4 = Maori ethnicity

5 = Gender

6 = Conduct problems (ages 7-9)

7 = Neuroticism (age 14)

8 = Novelty-seeking (age 16)

9 = Parental offending (ages 0-15)

10 = Childhood sexual abuse (ages 0-16)