



Is the relationship between early-onset cannabis use and educational attainment causal or due to common liability?



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ABSTRACT

Background: Several studies have shown that early cannabis use is correlated with poor educational performance including high school drop-out. The predominant explanation for this relationship is that cannabis use causes disengagement from education. Another explanation is that the association between early cannabis use and educational attainment is not causal, but the result of overlapping risk factors that increase the likelihood of both early cannabis use and disengagement from education. These confounding factors could be of genetic and/or environmental origin.

Methods: Here we use data from a large community-based sample of adult twins ($N = 3337$) who completed a comprehensive semi-structured telephone interview. We first apply the classical twin-design to determine whether genetic and/or environmental influences underlie the relationship between early-onset cannabis use (prior to age 18) and early school leaving. Next, with a co-twin control design we investigate whether the relationship between the two variables is more likely due to direct causality or overlapping risk factors.

Results: We find a significant phenotypic correlation between early-onset cannabis use and early school leaving ($r = 0.26$), which could be explained by familial influences (of genetic and/or shared environmental origin). The pattern of odds ratios found in the co-twin control design is not consistent with direct causation, but rather suggests that the association is due to shared environmental factors influencing both variables.

Conclusion: Our findings suggest that the relationship between early-onset cannabis use and school leaving is due to shared environmental risk factors influencing both the risk of early-onset cannabis use and early school leaving.

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1. Introduction

Cannabis is the most widely consumed illicit drug worldwide, and prevalence of use is especially high among adolescents and young adults (United Nations Office on Drugs and Crime, 2010). A large body of research has demonstrated the adverse effects of cannabis use; it is associated with accidents, violence, and use of other drugs (Hall, 2009; Huas et al., 2008) and regular use can cause physical or psychological problems (Fergusson and Horwood, 1997,

2000; Hall, 2009; Hall and Babor, 2000; Hall and Degenhardt, 2009; Hall and Solowij, 1998). Public health costs, law enforcement, and loss of productivity and work potential because of cannabis use are an economic drain on society (Hall and Babor, 2000).

Cannabis use is typically initiated during adolescence (Chen and Kandel, 1995) and given the widespread use and its negative effects on cognitive tasks and psychological functioning, there has been increasing concern about its adverse effects on a host of psychosocial outcomes, including educational attainment. Several studies have shown that early cannabis use is correlated with poor educational performance, including higher rates of absenteeism, worse school performance, higher drop-out rates, and failure to attend tertiary education (Bray et al., 2000; Fergusson et al., 2003, 1996; Horwood et al., 2010; Lynskey et al., 2003). In turn, educational attainment has a severe impact on future life opportunities; individuals that drop out of school are at risk for a range of

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negative outcomes, including reduced occupational opportunities and income, poorer health, and involvement in crime (Beauvais et al., 1996).

The predominant explanation for the relationship between cannabis use and educational attainment is that cannabis use causes educational difficulties (Brook et al., 1999; Fergusson and Horwood, 1997; Yamada and Kendix, 1996). Possible mechanisms underlying this hypothesised causal association are that (heavy) cannabis use may lead to cognitive or motivational deficits, which encourages decreased participation in education (see Lynskey et al., 2003).

An alternative explanation is that poor educational performance causes cannabis use. Rates of cannabis use are higher among adolescents not attending school (Swaim et al., 1997), leading to the hypothesis that early school leaving leads to cannabis use. However, this elevation in rates of cannabis use in early school leavers disappears when correcting for cannabis use prior to school drop-out (Fergusson et al., 2003), suggesting this hypothesis is incorrect.

Another alternative explanation is that the association between cannabis use and poor educational attainment is not causal, but the result of overlapping risk factors increasing the likelihood of both early cannabis use and poor educational achievement. These confounding factors could be of genetic and/or environmental origin. Both cannabis use and educational achievement are found to be substantially heritable, with genetic factors estimated to account for ~45% of variance in cannabis use initiation and ~60% of variance in educational achievement (Baker et al., 1996; Szanton et al., 2009; Verweij et al., 2010). Overlapping environmental risk factors could include social disadvantages, family dysfunction, parental substance use, and peer influences (Fergusson et al., 2003; Lynskey and Hall, 2000).

While this common causes explanation has been proposed before (Fergusson et al., 2003; Lynskey and Hall, 2000), only two studies have directly investigated this with a genetically informative sample. Surprisingly, Bergen et al. (2008) did not find a significant association between illicit drug use and educational attainment, but for drug abuse/dependence their findings suggested that the relationship with educational attainment is likely due to overlapping genetic factors that influence both traits. However, due to a lack of power they were not able to rule out a role for overlapping shared environmental influences. A limitation of their study is that they had no information on when the participants started using drugs, so they did not know whether drug use preceded or followed educational drop-out. In the second paper, Grant et al. (2012) tested whether alcohol, nicotine, and illicit drug use and dependence were associated with educational attainment (measured as more or less than 16 years of education). By using twin data they were able to investigate the role of substance use in educational attainment controlling for shared familial factors. They found that the association of cannabis initiation, early use, and dependence with educational attainment could be explained by overlapping familial factors, but were unable to distinguish between genetic and shared environmental influences. While this study had a large sample size and the findings make an important contribution to unravelling the relationship between substance use and educational attainment, their study also had some limitations. The sample was drawn from the Vietnam Era Twin Registry, so consisted only of males who had almost all completed high school (a requirement for military service at the time) and who had access to military educational benefits. Therefore, the findings may not be generalisable to the general population and to females. Also, as completion of high school was a requirement, the researchers were not able to examine the more immediate relationship between substance use and high school drop-out.

These two studies were the first genetically informative studies to empirically show that the relationship between cannabis use

Table 1

Prevalences of highest level of educational attainment, early school leaving, lifetime cannabis use, and cannabis use before the age of 18, for males and females separately.

	Males N = 1173 (35%)	Females N = 2164 (65%)
Primary school – incomplete	0 (0.0%)	1 (0.0%)
Primary school – complete	0 (0.0%)	1 (0.0%)
Year 8 complete	3 (0.3%)	6 (0.3%)
Year 9 complete	10 (0.9%)	11 (0.5%)
Year 10 complete	76 (6.5%)	102 (4.7%)
Year 11 complete	61 (5.2%)	82 (3.8%)
Year 12 complete	160 (13.6%)	301 (13.9%)
TAFE/Technical college	369 (31.5%)	573 (26.5%)
Undergraduate degree	296 (25.2%)	627 (29.0%)
Post-graduate degree	198 (16.9%)	460 (21.2%)
Early school leaving	150 (12.8%)	203 (9.4%)
Lifetime cannabis use	898 (76.6%)	1404 (64.9%)
Cannabis use initiated before the age of 18	525 (44.8%)	712 (32.9%)

and educational attainment is not likely to be causal, but due to overlapping familial factors. However, neither of them provided information about the relative importance of genetic and environmental influences to the relationship between cannabis use and educational attainment.

In the present study, we use a sample of 3337 male and female twins to more closely examine the relationship between cannabis use and educational attainment. We investigate the strength of the relationship between cannabis use before the age of 18 and early school leaving as well as the extent to which genetic, shared environmental, and residual factors contribute to this relationship. Furthermore, using the co-twin control design, we examine whether the association between early-onset cannabis use and school leaving is more likely explained by direct causation or by genetic or environmental factors influencing both variables.

2. Methods

2.1. Participants

Twins participating in this study were drawn from the Australian Twin Registry (ATR). Between 2006 and 2009 these twins participated in a comprehensive computer-assisted telephone interview administered by trained interviewers. This interview was aimed primarily at assessing links between correlates of cannabis use phenotypes. Written informed consent was obtained from all participants.

A total of 3337 twins (1173 males and 2164 females) completed the questions regarding cannabis use and educational attainment. Of these, 2302 (69%) reported lifetime (ever) cannabis use. Participants were aged between 27 and 40 years (mean \pm S.D = 31.9 \pm 2.5) and the sample included 571 identical (monozygotic; MZ), 653 non-identical (dizygotic; DZ) twin pairs, and 889 single twins (where only one twin of the pair participated). The zygosity of the twin pairs was determined based on responses to standard items about physical similarity, a procedure that has been found to have at least 95% concurrence with DNA typing (Ooki et al., 1990). For further details about the recruitment procedure and other study characteristics, see Lynskey et al. (2012).

2.2. Measures

2.2.1. Early-onset cannabis use. Twins were asked whether they had ever used cannabis, and (if they did) how old they were the first time they used cannabis. We grouped twins into two categories: those that used cannabis before the age of 18 (i.e. during high school), and those that never used cannabis or used for the first time when they were 18 or older. Table 1 shows the prevalences for lifetime cannabis use and use before the age of 18.

2.2.2. Early school leaving. Participants were asked for their highest completed educational level. Response options ranged from (1) 'primary incomplete' to (10) 'post-graduate degree' (see Table 1 for all response options and corresponding frequencies). In Australia, most people attend school for 12 years. Everyone is obliged to finish year 10 after which they are allowed to stop, but in order to be accepted for some tertiary education (e.g. university) they need to pass the year 12 exams. This variable was recoded into a dichotomous variable, where participants that did not finish year 12 (i.e. who reported year 11 or less as their highest level of education) were marked as early school leavers.

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