

Neuropsychological and educational outcomes related to adolescent cannabis use, a prospective cohort study

C. Mokrysz¹, S. Gage, R. Landy, M.R. Munafò, J.P. Roiser, H.V. Curran

¹Clinical Psychopharmacology Unit, University College London. Email: c.mokrysz.12@ucl.ac.uk

The author declares no conflicts of interest.



A recent longitudinal study by Meier *et al.* [1] suggested chronic heavy cannabis use and cannabis use disorder is associated with a decline in IQ from childhood to adulthood in adolescent-onset cannabis users, but not adult-onset users.

Here we assess the associations between intellectual and educational performance and adolescent cannabis use in the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort, attempting to replicate the findings of Meier *et al.* [1] in a new, larger sample.

Methods

Participants completed IQ tests at age 8 (WISC) and at age 15 (WASI); and a cannabis use questionnaire at age 15. Complete case sample size = 2235.

Regression analyses were employed to test the relationship between self-reported lifetime cumulative cannabis use at age 15 and:

a) standardised IQ score at age 15, controlling for pre-exposure standardised IQ score at age 8;

b) capped score of grades achieved at Key Stage 4 (% of total possible points), controlling for pre-exposure Key Stage 2 performance.

Both sets of analyses were adjusted in a series of nested models for potential confounders including sex, maternal education, pregnancy and early-life factors, mental health, and other drug and alcohol use.

Results

a) Adolescent IQ and cannabis use (Figure 1). With adjustment for full-scale IQ at age 8, cannabis use is associated with IQ at age 15 (Model 2; $p \leq .001$). Those who have used cannabis 50 or more times are estimated to have an IQ 2.94 points lower than never users, controlling for IQ at age 8.

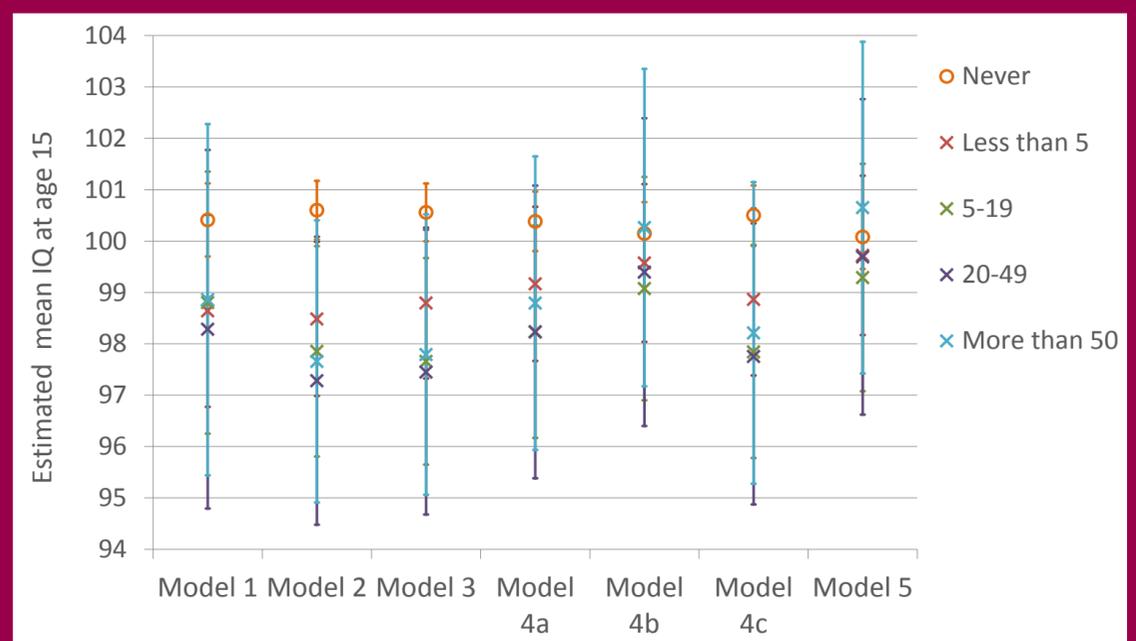
Adjustment by alcohol (Model 4a), cigarette (Model 4b), or other recreational drug use (Model 4c) attenuates the association between IQ age 15 and cannabis use.

Model 5 fully attenuates the association between cannabis use and IQ ($p = .924$); with cumulative use of 50 or more times now equating to an IQ score 0.52 points higher relative to never-users, with confidence intervals well crossing the null.

b) Educational outcome and cannabis use. With adjustment for Key Stage 2 performance, cannabis use is associated with Key Stage 4 performance ($p \leq .001$). Those who have used cannabis 50 or more times are estimated to have scored 10.96% lower than never users.

The fully adjusted model somewhat attenuates the association between cannabis use and Key Stage 4 performance ($p = .090$); with cumulative use of 50 or more times now equating to a Key Stage 4 score 2.87% lower relative to never-users ($p = 0.02$).

Figure 1. Linear regression nested models displaying association of cumulative lifetime cannabis use with estimated mean IQ at age 15



Model 1	Adjusted only by cumulative cannabis use at age 15
Model 2	As model 1 plus adjustment for full-scale IQ age 8
Model 3	As model 2 plus adjustment for maternal, early-life factors & mental health
Model 4a	As model 4 plus adjustment for cumulative alcohol use at age 15
Model 4b	As model 4 plus adjustment for cumulative cigarette use at age 15
Model 4c	As model 4 plus adjustment for other recreational drug use at age 15
Model 5	Fully adjusted

Key finding

The pattern of attenuation suggests rather than a specific effect of cannabis on IQ and education, any substance use at a young age, and the 'risky' lifestyle such behaviours reveal, are related to poorer outcomes. The analyses therefore do not support the findings of Meier *et al.* [1].

Limitations

Self-reported drug use estimates may be inaccurate. However repeating analyses using a frequency measure, which is likely to be more accurate, provides similar results.

Cannabis use is strongly correlated with other substance use, particularly cigarette smoking, which may be problematic when trying to separate variance related to different predictors.

Neuropsychological and educational outcomes related to adolescent cannabis use, a prospective cohort study

C. Mokrysz¹, S. Gage², R. Landy³, M.R. Munafò⁴, J.P. Roiser⁵, H.V. Curran¹

¹University College London, Clinical Psychopharmacology Unit, London, United Kingdom

²University of Bristol, School of Social and Community Medicine, Bristol, United Kingdom

³Wolfson Institute of Preventive Medicine, Centre for Cancer Prevention, London, United Kingdom

⁴University of Bristol, School of Experimental Psychology, Bristol, United Kingdom

⁵University College London, Institute of Cognitive Neuroscience, London, United Kingdom

Previous research has suggested heavy cannabis use in adolescence may lead to persistent neuropsychological deficits. However much of the research to date has been cross-sectional and therefore unable to assess whether pre-exposure group differences are driving the association. There is a considerable lack of consensus in the literature to date. A recent longitudinal study suggested chronic heavy cannabis use is associated with decline in IQ in adolescent-onset cannabis users, but not adult-onset users [1]. It is important however to investigate other possible explanations for this relationship, including the role of socioeconomic status as well as other drug and alcohol use, before drawing a causal conclusion.

The present study aimed to further explore the relationship between adolescent cannabis use and cognitive functioning in a new, larger sample, as well as assessing the relationship between cannabis use and educational outcomes. Participants were members of the ALSPAC cohort, a prospective study following 15,247 pregnancies with expected delivery between April 1991 and December 1992, from Avon, South-West England. Participants completed IQ tests pre-cannabis exposure at age 8 and again at age 15, and completed cannabis-use questionnaires at age 15. Data linkage with the National Pupil Database (a central repository for pupil level educational data in England) provided educational performance data for participants. Standardised change scores for full-scale IQ were calculated and regression analyses were employed to test the relationship between reported cannabis use and the outcomes of IQ change and educational performance.

Of a complete sample size of 2612, at age 15 years 24% reported trying cannabis at least once. Cannabis use was found to be associated with IQ decline ($p \leq 0.001$). Participants who reported using cannabis more than 100 times saw decline of 3.71 IQ points relative to never users ($p \leq 0.010$). However once other relevant factors (including sex, socioeconomic status, maternal factors, mental health, and other drug use) were included in the multivariate model the association was attenuated. In particular alcohol use was found to be strongly associated with IQ decline ($p \leq 0.001$), and appeared to explain much of the variance in IQ change associated with cannabis use. In those reporting moderate alcohol use (ever use quantity of 6–99 times) this association persisted after control for other relevant factors, however was no longer apparent for heavier alcohol users (ever use quantity of at least 100 times). No other factors were found to be predictive of IQ change. Similar analyses were conducted for educational performance at age 16, controlling for pre-exposure IQ. Cannabis use was no longer associated with educational outcome once controlling for the above factors, however cigarette use remained strongly predictive of educational outcome ($p \leq 0.001$).

The findings do not support the hypothesis that cannabis use in adolescence leads to persistent decline in cognitive functioning, once other possible confounding variables are accounted for. The finding that moderate but not heavier alcohol use was associated with IQ decline may relate to a detrimental effect of alcohol use in adolescence, warranting further investigation.

1. Meier, M.H., Caspi, A., Ambler, A., Harrington, H., Houts, R., et al., 2012. Persistent cannabis users show neuropsychological decline from childhood to midlife. *Proc Natl Acad Sci USA* 109(40): E2657-E2664.

Citation: Eur Neuropsychopharmacol. 2014;24(Suppl 2):S695

Keywords

Drug dependence & abuse: clinical

Epidemiology

Neurodevelopment