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Childhood social environmental and behavioural predictors of early adolescent onset cannabis use

RUNNING TITLE: Predictors Adolescent Cannabis Use

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Abstract

Introduction and Aims. This study prospectively investigates behavioural and social antecedents of different patterns of adolescent cannabis use, specifically, early adolescent onset cannabis use and late onset occasional use.

Design and Methods. The sample comprised 852 adolescents (53% female) drawn from the Australian arm of the International Youth Development Study. Data were collected via self-report surveys. Risk and protective factors from a modified version of the Communities That Care youth survey were measured in 5th Grade (mean (*M*) = 10.9 years, SD = 0.4). Frequency of cannabis use was measured at six time-points throughout adolescence (ages 12-19 years).

Results. Early adolescent onset cannabis use (10.7% of the sample [*n* =91]) was predicted by childhood family-related factors including poor family management, family history of antisocial behaviour and attachment to parents. Cigarette use and drinking until drunk were the strongest predictors of early adolescent onset cannabis use. Cumulative risks associated with community, family, peer/individual environments and early substance use (cigarettes, alcohol) in childhood were predictive of early adolescent onset cannabis use (e.g. relative risk ratio = 2.64; 95% confidence interval 1.40-4.97 for early substance use). Family and early substance use-related cumulative risks were predictive of late adolescent onset occasional cannabis use (*n*=231; 27%). Cumulative early substance use risk was the strongest independent predictor of both early adolescent onset and late adolescent onset occasional cannabis use.

Discussion and Conclusions. Primary prevention efforts should focus on reducing exposure and access to licit substances during late childhood and delaying the onset of use. Prevention

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and intervention targeted toward the family environment also appears likely to be important in the prevention of early adolescent onset cannabis use.

Keywords: adolescent; cannabis; risk factors; protective factors; latent class analysis.

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Introduction

Approximately 4% of the global population aged 15-64 years have used cannabis in the past year [1], making it the most commonly used illicit substance. Cannabis use appears higher among adolescents than adults (e.g. [2, 3]). Cannabis use and abuse places a costly burden internationally with economic impacts across multiple areas including health, public safety, crime, productivity and governance [4]. The social costs of cannabis use in Australia are estimated to be in the billions [5]. There is mounting evidence that early adolescent onset of cannabis use (prior to age 15 years) is associated with increased short- and long-term harms, relative to later onset use (from age 15 years), even when controlling for frequency of use.

Early adolescent cannabis use has numerous pervasive effects. In a study of chronic cannabis users, early adolescent onset users (before 15 years of age) had poorer cognitive performance in neuropsychological executive functioning tasks compared to later onset users (after 15 years of age) [6]. Higher impulsivity [7], altered brain activation during performance on cognitive tasks [8] aad lower white matter fibre tract integrity in certain regions of the brain [7], have been reported among early onset chronic users relative to healthy non-cannabis using controls. Early adolescent cannabis use has a negative impact on educational attainment [9], as well as subsequent onset and problems with cannabis and other illicit drugs [10-12]. Early, but not later adolescent onset cannabis use, has been linked with mental health problems [e.g. anxiety disorders, psychotic symptoms [3, 14] and problem behaviours (e.g. antisocial and violent behaviours; [12]). Therefore, preventing the onset of

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adolescent cannabis use in order to reduce its individual, social and economic burdens is of utmost importance.

Understanding the prospective predictors of early adolescent onset cannabis use is essential for prevention targeting modifiable predictors of behaviour, to prevent or reduce the impact on cannabis use and related social problems [15]. Longitudinal studies are best suited to this approach. The current study investigates prospective modifiable social environmental and behavioural predictors of adolescent cannabis use trajectories (longitudinal patterns), with a focus on the predictors of a trajectory of cannabis use characterised by early adolescent onset.

Predictors of early adolescent onset cannabis use

To aid in the prevention of cannabis use and long-term cannabis-related adverse outcomes, investigation of factors predicting early-onset use is vital. A prospective study of adolescents in The Netherlands [16] investigated late childhood predictors of cannabis onset between ages 12-14 years. Findings showed late childhood high-intensity pleasure and disruptive behaviours (e.g. conduct problems) were associated with early adolescent onset of cannabis use. Florey *et al*. [17] investigated late childhood (6^{th} grade) predictors of three cannabis use trajectories: early onset users, late onset users and non-users. Results showed that the early onset group scored the lowest on school factors, self-esteem, family relations and peer pressure resistance, and the highest on expectancies (indicating fewer negative substance related expectancies), relative to both non-users and late onset users. The late onset users' scores tended to be intermediate to those of the non-users and the early onset users.

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Previous studies of early adolescent onset cannabis use have largely chosen potential predictors based on cross-sectional correlates of cannabis use [18]; these predictors have been predominantly individual-level behavioural factors that longitudinally predict an increased likelihood of later problem behaviours (i.e. risk factors [16, 18]). The social developmental perspective argues the importance of considering the social environment in the development of problem behaviours such as substance use (e.g. alcohol, tobacco [19]), and highlights the importance of both risk and protective factors (the latter including those that are associated with a reduced likelihood of later problems, or that moderate the effects of risk factors).

The Communities That Care (CTC) youth survey is designed to comprehensively assess risk and protective factors across social environmental domains thought to be important in the development of youth behaviour [20]; community, family, school and peer/individual domains. This survey has been used to assess levels of social environmental risk and protection in order to facilitate the prioritisation of specific social environmental factors for prevention and/or intervention [21]. The present study adopts this social developmental framework and tests the utility of the CTC survey (modified for use in this context) for the prospective prediction of early adolescent onset cannabis use. Using this framework will enable determination of the social environmental and behavioural domains that provide the strongest prediction of early adolescent onset cannabis use, as well as identify aspects of the social environment and behaviour which increase risk for, or protect against, the onset of cannabis use. This information is important for informing the design and implementation of targeted prevention and intervention approaches within the environmental settings in which adolescents interact.

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The current study

We previously used latent class growth analysis to determine developmental trajectories of adolescent cannabis use among a large sample of Australian youth [12]. In that analysis, we identified three distinct cannabis use trajectory groups: abstainers, early onset users (from age 12 years) and late onset occasional users (from age 15 years). Using these groups, we successfully examined associations between group membership and a range of social and behavioural adjustment problems in young adulthood (average age 19) with early adolescent onset cannabis use associated with greatest harms.

In the current study we build upon our previous findings by analysing data from the same sample to investigate prospective social environmental and behavioural predictors of the three cannabis use trajectory groups, with a focus on early adolescent onset cannabis users. Based on previous studies [e.g. 17], we hypothesised that early adolescent onset cannabis use would be associated with: (i) the poorest risk and protective factor profiles across all social environmental (community, family, school and peer/individual) and behavioural domains, and with increased cumulative risk within each domain, relative to the abstainers group; (ii) greater cumulative risk within the family and school domains, relative to the late onset occasional use group; and (iii) specific behavioural risk factors including sensation seeking, rebelliousness and substance use, as well as reduced self-esteem, relative to the abstinent group.

Methods

Participants

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The sample was drawn from the International Youth Development Study, a long-term study investigating the development of healthy and problem behaviours among young people in Victoria, Australia, and Washington State, United States. The Victorian cohort, recruited into the study in 5th Grade, formed the analytic sample for the present study as this cohort had the most extensive data collection throughout adolescence. In 2002, 927 grade 5 students were recruited into this cohort from public and private schools in Victoria, Australia and surveyed. A state-representative sample was achieved through a two-stage cluster sampling approach. Full details on sampling and recruitment have been previously published [22, 23]. Briefly, in stage one, public and private schools were stratified according to geographic location, and schools were selected at random using a probability proportionate to grade-level size sampling procedure. In stage two, one grade 5 class within each school was selected at random.

The grade 5 cohort was resurveyed in grades 6, 7, 9, 10 and 11, and in their first-year post-secondary school (with excellent retention rates [24]; see Table 1 for sample characteristics). In our previous study, we used data from each time point to conduct group-based trajectory modelling, resulting in three adolescent trajectories: abstainers (*n*=530; 64.24%), early adolescent onset cannabis users (from age 12 years; *n*=91; 10.68%) and late adolescent onset occasional cannabis users (from age 15 years; *n*=231; 27.11%) [12]. Analyses for the present study are based on the 852 (55% female) individuals who were included in the group-based trajectory modelling and categorised into one of these three trajectory groups [12].

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Measures

Cannabis use. Frequency of past year cannabis use was measured in grades 6, 7, 9, 10 and 11 and first year post-secondary school using the item, "In the past year (12 months), on how many occasions (if any) have you used marijuana (pot, weed, grass)?". Response options included: Never (0), 1–2 times (1), 3–5 times (2), 6–9 times (3), 10–19 times (4), 20–29 times (5), 30–39 times (6), and 40 or more times (7). Detail on the use of this measure in the group-based trajectory modelling has been published previously [12]. To summarise, frequency of cannabis use among early adolescent onset users was approximately once a month by age 19. Late adolescent onset occasional users reported cannabis use approximately 3–5 times per year by age 19 [12].

Risk and protective factors. In grade 5, students completed the Australian adaptation of the CTC youth survey [25]. Descriptions of the 25 risk and 7 protective factors relevant to the current analyses can be found in the online supplementary material (refer Table S1).

Procedure

Ethics approval for data collection in Victoria was obtained from the Royal Children's Hospital Ethics in Human Research Committee and from the University of Melbourne Human Ethics in Research Committee. Permission to conduct research in schools was obtained from relevant state authorities for public and private schools, as well as the school principal. Parental consent and student assent were obtained. Surveys were group administered in the classroom setting and took approximately 60 minutes to complete. For the post-secondary school survey, participants were contacted by mail, email and/or phone and

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asked to complete the survey online, after providing informed consent. Participants received a small thank you gift or voucher after each survey.

Data analysis

Analyses were completed using Stata 13 [26]. Missing data were dealt with using multiple imputation by chained equations. The percentage of missing data on the risk and protective factor variables prior to imputation ranged from 0-20.71% (M = 1.84%). The imputation model contained all predictor (risk and protective factors) and outcome (cannabis use trajectory groupings) variables, as well as demographic and survey sample design characteristics (i.e. clustering of students in schools at recruitment and sample design weight). Fifty imputations were performed. Analyses were performed on the imputed data sets. Findings were consistent when repeated with non-imputed data (i.e. using list-wise deletion).

Adolescent cannabis use trajectory groupings (early onset cannabis users, abstainers, late onset occasional users) were derived from previous latent class growth analyses conducted on the sample [12]. First, a series of multinomial logistic regression analyses were performed to examine prospective associations between each individual risk and protective factor and the cannabis use trajectory groups, controlling for gender, parent education and sample design (i.e. sample weight and clustering of students in schools at recruitment). Next, a cumulative risk index for each social environmental and behavioural domain was calculated (i.e. community domain, family domain, school domain, peer/individual domain and early substance use domain). To do this, cut-points for identifying elevated levels of risk (for the

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risk factors) and reduced levels of protection (for the protective factors) were applied to each individual risk and protective factor using previously established methods for determining cut-points in the CTC survey [21, 27]. Then, the number of elevated risk factors/reduced protective factors within each domain were summed to produce the cumulative risk indices. The early substance use risk index incorporated measures of cigarette use, alcohol use, other illicit drug use (excluding cannabis) and drinking until drunk. Finally, multinomial logistic regression analyses were performed with each cumulative risk index predicting the cannabis use trajectory groups, controlling for gender, parent education and sample design (i.e. sample weight and clustering of students in schools at recruitment).

Results

Associations between individual risk and protective factors and cannabis trajectory groups

Table 2 presents the results of the partially adjusted multinomial regression analyses predicting adolescent cannabis trajectory groups from the grade 5 risk and protective factors. Community laws and norms favourable to drug use, perceived availability of drugs, poor family management, family history of antisocial behaviour, rebelliousness, sensation seeking, cigarette use and drinking until drunk were all associated with increased risk of membership in the early adolescent onset cannabis use relative to the abstinent group. Attachment to parents, family opportunities for prosocial involvement, family recognition for prosocial involvement and school recognition for prosocial involvement were all associated with

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reduced risk of membership in the early adolescent onset cannabis use group relative to the abstinent group.

Perceived availability of drugs, family history of antisocial behaviour, alcohol use and drinking until drunk increased the risk of membership in the late adolescent onset occasional cannabis use group relative to the abstinent group. Community disorganisation was associated with a reduced risk of membership in the late onset occasional cannabis use group relative to the abstinent group. Community disorganisation and perceived availability of drugs in the community were associated with increased risk for early adolescent onset use, relative to the late onset occasional group. Membership in the early adolescent onset use group was predicted by poor family management, rebelliousness and cigarette use, relative to membership in the late onset occasional group. Opportunities and rewards for prosocial involvement in the family environment and self-esteem were associated with reduced risk for early adolescent onset use.

Associations between cumulative risk indices and cannabis trajectory groups

Descriptive statistics for each of the cumulative risk indices (community, family, school, peer/individual and early substance use) are presented in Table 3. Table 4 presents the results of the multinomial regression analyses examining associations between the cumulative risk indices and each adolescent cannabis use trajectory group. In partially adjusted analyses, cumulative risk within the family and early substance use (cigarette, alcohol and illicit drug use and drinking until drunk) indices were associated with increased risk for late adolescent onset occasional cannabis use relative to the abstinent group. Cumulative risk within the community, family, peer/individual and early substance use indices were associated with

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increased risk of early adolescent onset cannabis use group relative to the abstinent group. Finally, cumulative risk within the community, school and early substance use indices were associated with increased risk for early adolescent onset use, relative to the late onset occasional group.

In fully adjusted analyses, cumulative risk within the family and early substance use indices were associated with increased risk of late adolescent onset occasional cannabis use, relative to the abstinent group. Cumulative risk within the early substance use index was the only statistically significant predictor of membership in the early adolescent onset cannabis use group. Finally, cumulative risk within the community index was associated with increased risk of early onset, relative to the late adolescent onset occasional use group.

Discussion

Our findings showed that early adolescent onset cannabis users had the poorest risk and protective factor profile across all indices. Relative to the abstinent group, cumulative risk within the community, family, peer/individual and early substance use indices all predicted early adolescent onset cannabis use. Early substance use, collectively examining cigarette, alcohol and illicit drug use and drinking until being drunk, emerged as the most potent independent predictor of both early onset and late adolescent onset occasional cannabis use. Both cigarette and alcohol use in late childhood predicted early and late adolescent onset cannabis use, respectively, relative to non-cannabis (abstinent) users.

The current study shows a broad range of risk factors during late childhood (5^{th}-6^{th} grade; age 10-11 years) are associated with subsequent early adolescent onset cannabis use

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(7^{th} grade; from age 12 years). As predicted, and consistent with previous research [17], risk factors associated with the family environment appear to be particularly important, as opposed to peer-related factors. There were no statistically significant peer-related factors for membership in the early adolescent onset cannabis use group, although the results show a trend for the influence of peer-related factors. It is noted the analyses may have been underpowered to detect small significant effects. Several significant family-related risk (e.g. poor family management practices) and protective (e.g. attachment to parents) factors emerged membership in the early adolescent onset cannabis use group, relative to the abstinent group. Cumulative risk within the family was also a statistically significant predictor of early adolescent onset cannabis use in the partially adjusted analyses. The family environment has previously been identified as an important predictor of early onset use of other substances, such as alcohol, in adolescence [23]. Family-related factors generally play a more important role in shaping health-related behaviour in childhood, while peer-related factors become relatively more influential throughout adolescence [28]. In contrast, with respect to family factors, only family history of antisocial behaviour was a statistically significant predictor of late adolescent onset occasional cannabis use, though cumulative risks within the family did also predict membership of this group.

Consistent with previous research [17], early adolescent onset cannabis use was associated with individual risk factors including rebelliousness and sensation seeking. These factors were not statistically associated with late adolescent onset occasional cannabis use. Rebelliousness was associated with an increased risk for early adolescent onset use, relative to the late onset occasional use. These findings suggest that children who initiate cannabis

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use in early adolescence show behavioural traits in childhood that may predispose them to seek novel and intense experiences, take risks and defy or resist authority. These individual traits may potential markers for identifying at-risk youth. The predictive effects of individual characteristics such as sensation-seeking and rebelliousness suggest the importance of tailoring preventive interventions to accommodate individual differences.

Contrary to predictions, school related factors appeared to have little role in influencing risk of membership in either adolescent cannabis use trajectory group. This finding is interpreted in the context of the statistical power of this study. School recognition for prosocial involvement was a protective factor for early adolescent onset cannabis use, relative to abstinence (that is, those low in school recognition were more likely to be members of the early onset group). There were no statistically significant school-related risk factors for early adolescent onset cannabis use and cumulative risk within the school domain did not predict early onset use. This finding may provide further specificity to previous research showing that early onset frequent cannabis use in adolescence has a robust negative impact on subsequent educational achievement [9]. Our findings lend support to the view that the reported association between early adolescent onset frequent cannabis use and poor educational achievement is not due to confounds from premorbid school-related risks among early onset cannabis users. Instead, mounting evidence suggests a cause and effect association whereby early adolescent onset use leads to increased risk of educational underachievement by way of several potential mediating pathways (such as neuro-physiological or social processes) [9].

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Finally, while specific community, family and peer/individual risk factors were associated with early onset cannabis use in adolescence, cigarette use and drinking until drunk had the highest relative risk ratios in these individual risk factor analyses. Similarly, cumulative risk associated with early substance use had the highest relative risk ratio in the analyses examining risk indices. Cumulative risk associated with early substance use also had the highest relative risk ratio in the analyses predicting late adolescent onset occasional cannabis use. However, of note, cumulative risk within the early substance use index was associated with increased risk of early onset cannabis use, relative to late onset occasional use. This suggests that risks associated with early use of multiple substances were higher for the early adolescent onset group, than the late onset occasional group. These findings highlight the importance of early licit substance use as a marker for later cannabis use, particularly the high risk, early onset pattern of use in adolescence. While our findings suggest that prevention and intervention within other important social environmental domains is warranted, given that risk associated with early use of substances emerged as the only statistically significant independent cumulative risk predictor in fully adjusted analyses, reducing availability and access to substances such as cigarettes and alcohol in childhood, and preventing or delaying early adolescent substance use, may be the most important targets for prevention. It should be noted that the risk ratios for the cumulative risk index predictors were relatively small, though statistically significant. Future research is required to investigate other important behavioural, cognitive, social environmental or genetic influences that increase risk of early adolescent onset cannabis use.

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These findings have implications for understanding the developmental aetiology of adolescent cannabis use. Based on the current findings it appears that, particularly with respect to early adolescent onset cannabis use, mid-childhood risk processes are implicated in the developmental aetiology. It has been suggested that risk factors that appear early in life can lead to subsequent cumulative and cascading risks as a consequence of the experience of early risk processes (i.e. a 'snowball' process [29]). On the other hand, this aetiology is distinguished from adolescent-onset risk processes which are suggested to be likened to a 'snowstorm' process, whereby healthy adolescents exposed to risks for long enough, and without protection through the secondary school years, can experience adverse health outcomes [29]. While the current study measured risk factors in mid-childhood (grade 5 primary school), it is possible that risk processes, both individual and social environmental, began earlier in life. Although programs targeting cumulative risk are complex to deliver, examples such as CTC, which select two or more interventions to target across multiple settings (i.e. family, community, peer group, schools) have been effective in reducing risks for a range of adolescent health and social problems [30]. Future research investigating antenatal and early childhood risks (e.g. maternal substance use during pregnancy, social environmental factors during infancy and early childhood), as well as temporal patterns in risk factors over the period of early childhood to early adolescence, will contribute to further understanding of the developmental aetiology of patterns of adolescent cannabis use.

This study has several strengths. First, the population-based sample was recruited to be state-representative. Second, good response and excellent retention rates were achieved [24]. Nonetheless, there are some limitations of this study that should be recognised. First, the

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cannabis use frequency measure employed in the group-based trajectory modelling [12] did not distinguish between very high levels of cannabis use. Therefore, both weekly and daily users would have endorsed the highest response option (40 or more times in past 12 months). However, given the relatively low frequencies of cannabis use reported by the sample (see Table S1), this would have had little impact on the findings [12]. Further, this study did not examine the type (e.g. socially) or volume/potency of cannabis use. We caution that significant findings may have arisen due to the multiple analyses conducted.

Second, cannabis use among Australian adolescents has declined over the past 20 years [2]. Earlier cohort studies of Australian adolescents have reported higher longitudinal rates of cannabis use than observed in the current study [e.g. 31]. Despite this, our cannabis use trajectory groups were found to be associated with prospective specific and cumulative behavioural and social environmental risk factors, and young adults experienced poorer behavioural adjustment [12], demonstrating the importance of examining cannabis use patterns even among relatively infrequent users. It is acknowledged that cumulative risk analyses bear limitations. Our analyses were based on the assumption that measures on each risk index carried the same weight, so that that greater risk for cannabis use arose from a greater number of risk exposures. Nonetheless, this study was able to investigate predictors of early adolescent onset cannabis use, which is associated with various short- and long-term negative consequences, even when controlling for frequency of use [8]. The risk and protective factors identified in the current study have also been associated with adolescent alcohol initiation [32]. Therefore, it is possible that these represent risk and protective factors for early onset adolescent substance use in general. Future research investigating longitudinal

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adolescent trajectories of both alcohol and cannabis use, and the childhood predictors of these, would allow understanding of similarities and differences in onset and patterns of adolescent alcohol and cannabis use, and whether the predictors of these patterns differ depending on substance/s used. Finally, this study relied on self-report survey data. Although this methodology may be subject to socially desirable responding and biases, self-report methods offer a reliable and valid means to assess adolescent substance use [33].

Conclusion

Risk and protective factors captured by the CTC youth survey predict adolescent trajectories of cannabis use with early substance use (cigarettes, alcohol, other illicit drugs besides cannabis) the strongest independent risk factor for subsequent early onset cannabis use. Primary prevention efforts focussed on reducing availability and access to these substances during late childhood and early adolescence seem likely to be effective in delaying the onset of cannabis initiation.

Given the importance of the family environment in also influencing likelihood of early adolescent onset cannabis use, family-targeted prevention focused on antisocial behaviour and poor family management seem likely to be a further useful strategy. Ultimately multi-component prevention programs, addressing cumulative risks across multiple contexts, seem likely to be most effective in preventing early cannabis use and ultimately other illicit substance use.

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References

1. United Nations Office on Drugs and Crime. World Drug Report 2014. New York: United Nations; 2014.

2. Australian Institute of Health and Welfare. National Drug Strategy Household Survey detailed report 2013. Drug statistics series no. 28. Cat. no. PHE 183. Canberra, Australia: Australian Institute of Health and Welfare; 2014.

3. Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE, Miech RA. Monitoring the Future national survey results on drug use, 1975-2013: Volume I, Secondary school students. Ann Arbor: Institute for Social Research, The University of Michigan; 2014.

4. International Narcotics Control Board. Report of the International Narcotics Control Board for 2013 Chapter 1 2013: https://www.incb.org/incb/en/publications/annual-reports/annual-report-2013.htm

5. Moore T. Monograph No. 14: Working estimates of the social costs per gram and per user for cannabis, cocaine, opiates and amphetamines. Sydney, Australia: National Drug and Alcohol Research Centre; 2007.

6. Fontes MA, Bolla KI, Cunha PJ, Almeida PP, Jungerman F, Laranjeira RR, et al. Cannabis use before age 15 and subsequent executive functioning. Br J Psychiatry 2011;198:442-7.

7. Gruber SA, Dahlgren MK, Sagar KA, Gönenç A, Lukas SE. Worth the wait: Effects of age of onset of marijuana use on white matter and impulsivity. Psychopharmacology (Berl) 2014;231:1455-65.

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8. Sagar KA, Dahlgren MK, Gönenç A, Racine MT, Dreman MW, Gruber SA. The impact of initiation: Early onset marijuana smokers demonstrate altered Stroop performance and brain activation. Dev Cogn Neurosci 2015;16:84-92.

9. Horwood LJ, Fergusson DM, Hayatbakhsh MR, Najman JM, Coffey C, Patton GC, et al. Cannabis use and educational achievement: Findings from three Australasian cohort studies. Drug Alcohol Depend 2010;110:247-53.

10. Agrawal A, Grant JD, Waldron M, Duncan AE, Scherrer JF, Lynskey MT, et al. Risk for initiation of substance use as a function of age of onset of cigarette, alcohol and cannabis use: findings in a Midwestern female twin cohort. Prev Med 2006;43:125-8.

11. Lynskey MT, Heath AC, Bucholz KK, Slutske WS, Madden PA, Nelson EC, et al. Escalation of drug use in early-onset cannabis users vs co-twin controls. JAMA 2003;289:427-33.

12. Scholes-Balog KE, Hemphill SA, Evans-Whipp TJ, Toumbourou JW, Patton GC. Developmental trajectories of adolescent cannabis use and their relationship to young adult social and behavioural adjustment: A longitudinal study of Australian youth. Addict Behav 2016;53:11-8.

13. Degenhardt L, Coffey C, Romaniuk H, Swift W, Carlin JB, Hall WD, et al. The persistence of the association between adolescent cannabis use and common mental disorders into young adulthood. Addiction 2013;108:124-33.

14. Hall W. Dissecting the causal anatomy of the link between cannabis and other illicit drugs. Addiction 2006;101:472-3.

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15. Catalano RF, Fagan AA, Gavin LE, Greenberg MT, Irwin Jr CE, Ross DA, et al. Worldwide application of prevention science in adolescent health. Lancet 2012;379:1653-64.

16. Creemers HE, Van Lier PA, Vollebergh WA, Ormel J, Verhulst FC, Huizink AC. Predicting onset of cannabis use in early adolescence: the interrelation between high-intensity pleasure and disruptive behavior. The TRAILS study. J Stud Alcohol Drugs 2009;70:850-8.

17. Flory K, Lynam D, Milich R, Leukefeld C, Clayton R. Early adolescent through young adult alcohol and marijuana use trajectories: Early predictors, young adult outcomes, and predictive utility. Dev Psychopathol 2004;16:193-213.

18. Windle M, Wiesner M. Trajectories of marijuana use from adolescence to young adulthood: Predictors and outcomes. Dev Psychopathol 2004;16:1007-27.

19. Bronfenbrenner U. Ecological models of human development. In: Gauvain M, Cole M, editors. Readings on the development of children. 2. New York: Freeman; 1993. p. 37-43.

20. Catalano RF, Hawkins JD. The Social Development Model: A Theory of Antisocial Behavior. In: Hawkins JD, editor. Delinquency and Crime: Current theories. New York: Cambridge University Press; 1996. p. 149-97.

21. Arthur MW, Briney JS, Hawkins JD, Abbott RD, Brooke-Weiss BL, Catalano RF. Measuring risk and protection in communities using the Communities That Care Youth Survey. Eval Program Plan 2007;30:197-211.

22. McMorris BJ, Hemphill SA, Toumbourou JW, Catalano RF, Patton GC. Prevalence of substance use and delinquent behavior in adolescents from Victoria, Australia and Washington State, United States. Health Edu Behav 2007;34:634-50.

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23. Scholes-Balog KE, Hemphill S, Reid S, Patton G, Toumbourou J. Predicting early initiation of alcohol use: A prospective study of Australian children. Subst Use Misuse 2013;48:343-52.

24. Heerde JA, Toumbourou JW, Hemphill S, Le H, Herrenkohl TI, Catalano RF. Prevent crime and save money: Application of return-on-investment models in the Australian context. Trends and Issues in Crime and Criminal Justice 2018;545:1-19.

25. Hemphill SA, Heerde JA, Herrenkohl TI, Patton GC, Toumbourou JW, Catalano RF. Risk and protective factors for adolescent substance use in Washington State, the United States and Victoria, Australia: A longitudinal study. J Adolesc Health 2011;49:312-20.

26. StataCorp LLC. Stata: Statistics/data analysis. Release 13 ed. College Station, TX: StataCorp LLC; 2013.

27. Briney JS, Brown EC, Hawkins JD, Arthur MW. Predictive validity of established cut points for risk and protective factor scales from the Communities That Care Youth Survey. J Prim Prev 2012;33:249-58.

28. Horwood LJ, Fergusson DM, Coffey C, Patton GC, Tait R, Smart D, et al. Cannabis and depression: An integrative data analysis of four Australasian cohorts. Drug Alcohol Depend 2012;126:369-78.

29. Toumbourou JW, Catalano RF. Predicting developmentally harmful substance use. In: Stockwell T, Gruenewald O, Toumbourou JW, Loxley W, editors. Preventing harmful substance use: The evidence base for policy and practice. London, England: Wiley; 2005. p. 53-66.

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30. Toumbourou JW, Rowland B, Williams J, Smith R, Patton GC. Community intervention to prevent adolescent health behavior problems: Evaluation of communities that care in Australia. Health Psychol 2019;38:536-44.

31. Swift W, Coffey C, Carlin JB, Degenhardt L, Patton GC. Adolescent cannabis users at 24 years: Trajectories to regular weekly use and dependence in young adulthood. Addiction 2008;103:1361-70.

32. Donovan JE. Adolescent alcohol initiation: A review of psychosocial risk factors. J Adolesc Health 2004;35:529. e7-e18.

33. Winters KC, Stinchfield RD, Henly GA, Schwartz RH. Validity of adolescent self-report of alcohol and other drug involvement. Int J Addict 1990;25(Suppl 11):1379-95.

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Table 1.

Demographic data and cannabis use for the sample at each wave

	Grade 5	Grade 6	Grade 7	Grade 9	Grade 10	Grade 11	1st year post-secondary
n	927	906	892	783	823	779	800
Retention rate (%)	-	97.7	96.2	84.5	88.8	84.0	86.3
Female (%)	51.9	51.9	51.9	51.9	51.6	51.9	54.9
Exact age (mean/SD)	10.98 (0.40)	11.94 (0.39)	12.95 (0.39)	15.15 (0.38)	15.99 (0.39)	17.00 (0.41)	19.03 (0.44)
Average frequency of past year cannabis use (mean/SD) at each wave for each cannabis trajectory							
Abstinent (*n*= 530)	0	0	0	0	0	0	0

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Late onset occasional (*n*=231)	N/A	0	0.04 (0.48)	0.09 (0.56)	0.20 (0.85)	0.67 (1.22)	1.97(1.90)
Early onset (*n*=91)	N/A	0.20 (1.06)	0.23 (0.91)	1.44 (1.76)	2.71 (2.33)	3.21 (2.34)	3.43 (2.77)

Note. N/A- not available as the measure of cannabis use in grade 5 assessed presence/absence of lifetime cannabis use, not frequency of past year use. Scale for average frequency of past year cannabis use measure: never (0), 1 or 2 times (1), 3 to 5 times (2), 6 to 9 times (3), 10 to 19 times (4), 20 to 29 times (5), 30 to 39 times (6) and 40+ times (7).

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Table 2.

Partially adjusted associations between grade 5 risk and protective factors and adolescent cannabis use trajectories

Risk/protective factor^	Early onset (*n* = 91)		Late onset occasional (*n* = 231)		Early onset vs. late onset occasional (*n* = 322)	
	RRR	*P*	RRR	*P*	RRR	*P*
Community risk						
Low neighbourhood attachment	1.17	0.270	0.88	0.221	1.37	0.056
Community disorganisation	1.49	0.121	0.61	0.037	2.41	0.003
Transitions and mobility	1.39	0.117	1.00	0.977	1.41	0.100
Laws/norms favourable to drug use	1.76	0.027	1.24	0.193	1.38	0.186
Perceived availability of drugs	2.37	<0.001	1.61	0.004	1.50	0.022
Community protective						
Opportunities for prosocial involvement	0.82	0.356	1.10	0.470	0.86	0.454

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Recognition for prosocial involvement	0.87	0.431	1.11	0.341	0.82	0.147
Family risk						
Poor family management	2.66	0.003	1.09	0.694	2.43	0.018
Family conflict	1.09	0.579	1.22	0.110	0.90	0.592
Family history of antisocial behaviour	2.33	<0.001	1.70	0.006	1.47	0.090
Parental attitudes favourable to drug use	1.11	0.664	1.09	0.646	1.01	0.982
Parental attitudes favourable to antisocial behaviour	1.26	0.269	0.95	0.752	1.47	0.308
Family protective						
Attachment to parents	0.69	0.023	0.93	0.671	0.74	0.084
Opportunities for prosocial involvement	0.72	0.042	1.07	0.618	0.67	0.043
Recognition for prosocial involvement	0.62	0.019	1.01	0.964	0.60	0.048
School risk						
Academic failure	1.45	0.096	1.14	0.413	1.33	0.343

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Low school commitment	1.53	0.093	1.03	0.840	1.45	0.106
School protective						
School recognition for prosocial involvement	0.56	0.009	0.82	0.288	0.73	0.218
Peer/individual risk						
Rebelliousness	1.75	0.004	1.22	0.209	1.47	0.046
Favourable attitudes towards antisocial behaviour	1.12	0.529	0.95	0.748	1.22	0.369
Favourable attitudes towards drug use	0.87	0.507	1.09	0.621	0.72	0.232
Perceived risks of drugs	1.05	0.782	0.80	0.106	1.35	0.147
Interaction with antisocial peers	1.21	0.438	0.99	0.969	1.20	0.545
Sensation seeking	1.32	0.007	1.19	0.088	1.11	0.302
Recognition for antisocial involvement	1.08	0.476	1.13	0.207	0.92	0.633
Depressive symptoms	1.00	0.898	0.98	0.319	1.21	0.618
Cigarette use	5.63	<0.001	1.61	0.085	3.54	0.005

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Alcohol use	1.63	0.068	1.94	0.001	0.83	0.547
Illicit drug use	1.63	0.394	1.29	0.579	0.86	0.841
Drinking until drunk	8.28	0.001	2.53	0.042	3.22	0.075
Peer/individual protective						
Self esteem	0.64	0.060	1.31	0.196	0.52	0.004

^Descriptive statistics (including scale range) for the risk/protective factors can be found in the online supplementary material (refer Table S1). The base outcome for all RRR's is the abstinent group (*n* = 530). Analysis of grade 5 cannabis use as a predictor of cannabis use trajectories could not be completed reliably due to a small number of children reporting lifetime cannabis use in grade 5 (n = 3). Analyses are partially adjusted for gender, parent education and sample design (i.e. sample weight and clustering of students in schools at recruitment). RRR, relative risk ratio.

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Table 3.

Descriptive statistics for cumulative risk indices by adolescent cannabis use trajectory group

	Possible range	Late onset occasional M (SD)	Abstinent M (SD)	Early onset M (SD)
Community risk index	0-7	2.87 (1.81)	2.85 (1.76)	3.56 (1.92)
Family risk index	0-8	3.18 (2.25)	2.79 (2.08)	3.84 (2.24)
School risk index	0-3	0.94 (0.91)	0.97 (0.91)	1.25 (0.97)
Peer/individual risk index	0-9	3.54 (2.43)	3.33 (2.09)	4.22 (2.57)
Early substance use risk index	0-5	0.18 (0.52)	0.11 (0.37)	0.42 (0.65)

Note. Community risk index incorporates neighbourhood attachment, community disorganisation, transitions and mobility, laws and norms favourable to drug use, perceived availability of drugs, opportunities for prosocial involvement and recognition for prosocial involvement. Family risk index incorporates poor family management, family conflict, family history of antisocial behaviour, parental attitudes favourable to drug use, parental attitudes favourable to antisocial behaviour, attachment to parents, family opportunities for prosocial involvement and family recognition for prosocial involvement. School risk index incorporates academic failure, low school commitment and school recognition for prosocial involvement. Peer/individual index incorporates rebelliousness, favourable attitudes towards antisocial behaviour, favourable attitudes towards drug use, perceived risks of drugs, interaction with antisocial peers, sensation seeking, recognition for antisocial involvement, depression and self-esteem. Early substance use risk index incorporates: Cigarette use, alcohol use, other illicit drug use (besides cannabis) and drinking until drunk.

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Table 4.

Associations between grade 5 cumulative risk indices and adolescent cannabis use trajectories

Cumulative risk index^	Late onset occasional vs. abstinent [a]			Early onset vs. abstinent [a]			Early onset vs. late onset [b]		
	RRR	95% CI	*P*	RRR	95% CI	*P*	RRR	95% CI	*P*
Partially adjusted									
Community risk index	1.00	0.91, 1.10	0.936	1.23	1.04, 1.46	0.014	1.24	1.07, 1.44	0.006
Family risk index	1.09	1.01, 1.19	0.028	1.22	1.07, 1.39	0.003	1.12	0.98, 1.28	0.099
School risk index	0.94	0.78, 1.15	0.564	1.33	1.00, 1.78	0.051	1.41	1.04, 1.92	0.029
Peer/individual risk index	1.03	0.95, 1.11	0.472	1.15	1.01, 1.30	0.041	1.11	0.98, 1.27	0.096
Early substance use risk index	1.54	1.12, 2.10	0.008	3.01	1.67, 5.41	<0.001	1.96	1.10, 3.48	0.023
Fully adjusted									

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Community risk index	0.95	0.85, 1.06	0.338	1.13	0.95, 1.34	0.157	1.19	1.02, 1.40	0.029
Family risk index	1.14	1.02, 1.27	0.018	1.09	0.94, 1.27	0.244	0.96	0.81, 1.13	0.598
School risk index	0.85	0.67, 1.07	0.159	1.05	0.78, 1.40	0.746	1.23	0.89, 1.72	0.206
Peer/individual risk index	0.98	0.90, 1.08	0.721	0.97	0.81, 1.16	0.749	0.99	0.84, 1.17	0.886
Early substance use risk index	1.47	1.06, 2.04	0.023	2.64	1.40, 4.97	0.003	1.80	0.98, 3.29	0.057

^Scale range for each cumulative risk index are located in Table 3. [a] The base outcome is the abstinent group. [b] The base outcome is the late onset occasional use group. For partially adjusted analyses, each cumulative risk index is analysed separately adjusting for gender, parent education and sample design (i.e. sample weight and clustering of students in schools at recruitment). In fully adjusted analyses, all cumulative risk indices are included within the one model. Early substance use risk index incorporates: Cigarette use, alcohol use, other illicit drug use (besides cannabis) and drinking until drunk. CI, confidence interval; RRR, relative risk ratio.

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