

Prospective polysubstance use profiles among adolescents with early-onset cannabis use, and their association with cannabis outcomes in emerging adulthood

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The Québec Longitudinal Study of Child Development has received funding from the ministère de la Santé et des Services sociaux, le ministère de la Famille, le ministère de l'Éducation et de l'Enseignement supérieur, the Lucie and André Chagnon Foundation, the Institut de recherche Robert-Sauvé en santé et en sécurité du travail, the Research Centre of the Sainte-Justine University Hospital, the ministère du Travail, de l'Emploi et de la Solidarité sociale and the Institut de la statistique du Québec. Additional funding was received by the Fonds de Recherche du Québec - Santé (FRQS; 36778), the Fonds de Recherche du Québec - Société et Culture (FRQSC; 2002-RS-79238, 2009-RG-124779,

2021-RG11-281152), the Social Science and Humanities Research Council of Canada (SSHRC; 410-99-1048 and 839-2000-1008), the Canadian Institutes of Health Research (CIHR; Grants OGE 111395 and MOP 114984) and grants in collaboration with the Canadian Centre on Substance Use and Addiction (CU3-163012 and PJT-165824). Nina Pocuca is supported by a Canadian Institutes of Health Research fellowship (MFE-176629). None of the funding sources had a role in the study design, collection, analysis or interpretation of the data, writing of the manuscript, or the decision to submit the paper for publication. Data appearing in this manuscript have not been previously presented or published elsewhere.

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Running title: polysubstance use profiles

Word count: 3,996

Declarations of interest: None

## Abstract

Background: Research is yet to elucidate the profiles of adolescent polysubstance use among youth with early-onset cannabis use (CU;  $\leq 15$  years). The present study aimed to fill this gap in the literature and determine whether CU outcomes in early adulthood are best explained by early-onset CU alone, or by the resulting polysubstance use profiles. Methods: Participants were  $N=794$  youth (56% females) from the Québec Longitudinal Study of Child Development, who reported lifetime cannabis use by age 21. Participants were stratified into early-onset ( $n=349$ ), later adolescent-onset (16-18 years;  $n=359$ ), and adult-onset ( $\geq 19$  years;  $n=86$ ) CU groups. Self-reported substance use was collected from the early-onset CU group at age 15 and 17, while CU frequency and problem CU were assessed for all participants at age 21. Results: Repeated measures latent profile analyses revealed four polysubstance use profiles among youth in the early-onset CU group: (1) light (54%); (2) escalating (13%); (3) frequent (without cigarettes; 14%); (4) frequent (with cigarettes; 19%). Only youth in the early-onset CU group who followed an escalating or frequent (with cigarettes) adolescent polysubstance use profile had consistently greater CU frequency and problem CU at 21 years, than youth in the later adolescent-onset (16-18 years), or adult-onset ( $\geq 19$  years) CU groups ( $\beta$  range=.13 to .40; Cohen's  $f^2$  range=.02 to .12). Conclusions: Youth with early-onset CU are not a single homogenous group, but rather follow unique polysubstance use profiles that are differentially associated with risk for future problem CU.

*Keywords:* Early-onset; cannabis use; polysubstance use; substance use; adolescence; emerging adulthood

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## 1. Introduction

A recent meta-analysis estimated that about one in five individuals who use cannabis have a cannabis use (CU) disorder (Leung, Chan, Hides, & Hall, 2020). One demographic particularly susceptible to CU disorder are emerging adults (18-25 years), given they engage in CU at higher rates than any other age group (i.e., one in two Canadian and one in three US emerging adults (18-25 years) reported CU in 2019; Government of Canada, 2019; Substance Abuse and Mental Health Services Administration, 2020). Thus, research is needed to examine factors that contribute to problem CU among emerging adults. Ultimately, identifying strong risk factors for problem CU is foundational to the development of effective prevention and intervention programs and will allow for the allocation of resources to the most at-risk youth.

Early-onset CU (commonly defined as  $\leq 15$  years), is one risk factor associated with the development of problem CU. Namely, youth with early-onset CU have up to 2.7 times greater risk of experiencing problem CU in their twenties, compared to youth who start using cannabis later in life (Han, Compton, Blanco, & Jones, 2019; Merrin, Leadbeater, Sturgess, Ames, & Thompson, 2021; Moss, Chen, & Yi, 2014; Swift, Coffey, Carlin, Degenhardt, & Patton, 2008). However, not all youth with early-onset CU will develop problem CU. This variability in the development of problem CU among youth with early-onset CU may be attributable to the heterogeneity in adolescent CU patterns among this group.

While longitudinal studies have demonstrated heterogeneity in CU patterns among people who use cannabis (regardless of age of onset; Nelson, Van Ryzin, & Dishion, 2015; Thompson, Merrin, Ames, & Leadbeater, 2018; Windle & Wiesner, 2004), research is yet to elucidate the profiles of adolescent CU seen among youth with early-onset CU. Identifying

the patterns of CU among youth with early-onset CU may be critical to understanding risk for future problem CU. For instance, youth with early-onset CU who follow a heavier CU profile across adolescence (e.g., weekly CU) may have increased risk of problem CU in emerging adulthood, compared to youth with later-onset CU. Conversely, youth with early-onset CU who only use cannabis a handful of times during adolescence, may not have increased risk of problem CU in emerging adulthood, compared to youth with later-onset CU. Indeed, such findings have been reported in the alcohol use literature (Yuen et al., 2020). While research is needed to examine CU profiles among youth with early-onset CU, the role of other substance use should also be considered.

Polysubstance use (the consumption of more than one substance either concurrently or at different times, within the same 12-month period) among youth who use cannabis, is associated with up to 2.6 greater odds of experiencing problem CU later in life, compared to cannabis use alone (Agrawal et al., 2011; Fairman, 2015; Lipperman-Kreda, Gruenewald, Grube, & Bersamin, 2017; Lopez-Quintero & Anthony, 2015; Lopez-Quintero et al., 2018). Concerningly, polysubstance use is common among youth who use cannabis (Merrin, Thompson, & Leadbeater, 2018; Tomczyk, Isensee, & Hanewinkel, 2016; Zuckermann et al., 2019). For instance, in their large study of Canadian high school students, Zuckermann et al. (2019) found that while only 5% of youth reported only using cannabis, around 34% reported using cannabis and at least one other substance (predominantly alcohol), in the past 12 months. What remains unclear, however, is how youth with early-onset CU in particular differ in their profiles of polysubstance use across adolescence and how these risk profiles are associated with future problem CU. Thus, the aims of the present longitudinal study were to: (1) examine the different profiles of adolescent polysubstance use among youth with early-onset CU ( $\leq 15$  years); and (2) determine whether CU outcomes in early adulthood are best

explained by early-onset CU alone, or by the resulting polysubstance use profiles among youth with early-onset CU.

## **2. Method**

### **2.1. Participants**

Data were drawn from the Québec Longitudinal Study of Child Development (QLSCD), a birth cohort study led by the Institut de la statistique du Québec. QLSCD comprises a stratified random sample of youth both in Quebec, Canada between 1997-1998, who were eligible for participation if they had a gestation period of 24-42 weeks and their mother spoke English or French (95% of eligible participants,  $N=2,120$ , were enrolled in the QLSCD; Orri et al., 2021). The present study used data from  $N=798$  youth (56% females) who reported lifetime CU by 21 years and completed questions regarding past 12-month CU at 12, 13, and 15 years, as this allowed for the prospective assessment of early-onset CU. Compared to the broader QLSCD sample, participants included in the present study were more likely to be female, have parents that were still together at 12 years, and be prenatally exposed to alcohol. They did not differ according to birth weight, participant emotional troubles (reported by the mother at 29 months), mother's age or depression (at 5 months), or socioeconomic status (at 5 months; see Supplemental Table 1). The QLSCD protocol was approved by the Institut de la statistique du Québec and the St-Justine Hospital Research Centre ethics committees. Written informed consent and assent were obtained from the parent and youth respectively at each survey, prior to participation.

### **2.2. Measures**

**2.2.1. Cannabis use onset.** At 12, 13, and 15 years, participants indicated whether they used cannabis in the preceding 12 months, with participants categorized into the early-onset CU group if they reported CU at any of the timepoints ( $n=353$ ; 44%). Age at CU onset reported retrospectively at 21 years was used to categorize remaining participants into later

adolescent-onset (16-18 years;  $n=359$ ) and adult-onset ( $\geq 19$  years, in line with the minimum legal age for CU in most Canadian provinces (Government of Canada, 2019);  $n=86$ ).

**2.2.2. Adolescent substance use among youth with early-onset cannabis use.** Cannabis, alcohol, cocaine, inhalant, hallucinogen, heroin, amphetamine, and non-prescribed medication use were assessed separately at 15 and 17 years, using the Detection of Alcohol and Drug Problems in Adolescents scale, which has excellent validity and reliability (Landry, Tremblay, Guyon, Bergeron, & Brunelle, 2004). Namely, participants were asked “during the past 12 months, how often did you use [substance]”, with responses recorded as 0 (never) 1 (just once to try) 2 (<monthly/occasionally) 3 (monthly) 4 (weekends or 1-2 times per week) 5 ( $\geq 3$  times per week but not everyday) 6 (everyday). Past 12-month use of substances other than alcohol or cannabis was recoded into a single binary variable [0 (no), 1 (yes)], given the less frequent use of these substances among Canadian adolescents (Institut de la statistique du Québec, 2021). Finally, cigarette use was assessed via the question: “Have you ever tried cigarette smoking, even just a few puffs?”. Participants who responded in the affirmative were then asked: “In the last 12 months, how often did you smoke?”. Cigarette use was recorded as 0 (never in lifetime) 1 (lifetime smoking, but not in past 12 months) 2 (occasionally) 3 (monthly) 4 (weekends or 1-2 times per week) 5 ( $\geq 3$  times per week but not everyday) 6 (everyday).

**2.2.3. Problem cannabis use in emerging adulthood.** At age 21, participants completed the 6-item Cannabis Abuse Screening Test (CAST; Cuenca-Royo et al., 2012; Legleye, Karila, Beck, & Reynaud, 2007). Responses were recorded on a 5-point Likert scale [0 (never) to 4 (very often)]. The CAST has good sensitivity and specificity, internal consistency, test-retest reliability, and discriminative validity in emerging adulthood, with scores  $\geq 7$  indicative of moderate-to-severe CU disorder (Cuenca-Royo et al., 2012; Legleye et al., 2007). The CAST had high reliability in the present sample (Cronbach’s  $\alpha=.84$ ).

**2.2.4. Covariates.** The following covariates, which have been associated with youth substance use, were adjusted for: sex (assigned at birth; [0 (male), 1 (female)]); childhood socioeconomic status at 5 months (variable aggregating parent income, education, and job prestige); family composition at 12 years [0 (not intact) 1 (intact)]; and frequency of prenatal alcohol exposure reported by the mother at 5 months [1 (none) to 7 (daily)] (Duko et al., 2022; Stone, Becker, Huber, & Catalano, 2012). We additionally controlled for current employment, studying, and independent living (without parents) at 21 years [0 (no), 1 (yes)], given these variables are associated with CU in emerging adulthood (Keyzers, Lee, & Dworkin, 2020; Schulenberg et al., 2018; Snyder & Merritt, 2015; Staff et al., 2010). While parenthood has been associated with decreased CU in emerging adulthood (Staff et al., 2010), we did not control for it given low prevalence in the present sample ( $n=3$ ).

### **2.3. Data Analysis**

Statistical analyses were conducted in several steps. First, regressions examined differences between youth with early-onset CU ( $\leq 15$  years), versus youth with later adolescent-onset (16-18 years) and adult-onset ( $\geq 19$  years) CU, on CU frequency and CAST score in emerging adulthood (21 years). Second, adolescent polysubstance use profiles among the group of youth with early-onset CU were examined using repeated measures latent profile analyses (RMLPA; also referred to as repeated measures latent class analyses), an ecologically valid approach for examining polysubstance use profiles (Tomczyk et al., 2016). The four substance use variables assessed at 15 and 17 years (i.e., cannabis, alcohol, cigarette, and other substance use) were used as latent profile indicators for the RMLPA. Several latent profile solutions were fit to the data. The best solution was determined via inspection of fit indices (i.e., Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample size adjusted BIC, wherein smaller values are indicative of better fit), the Lo–Mendell–Rubin likelihood ratio test (Nylund, Asparouhov, & Muthén, 2007), and



conceptual appeal and parsimony. Residual correlations among factor indicators were also examined to assess whether the best fitting model met the LPA assumption of local independence (Asparouhov & Muthén, 2015). Finally, classification quality was assessed via the entropy metric, with values  $\geq .80$  indicative of negligible latent profile measurement error, allowing for the use of most likely latent profile membership as a reliable predictor in subsequent regressions (Asparouhov & Muthén, 2021). Third, once the optimal number of profiles was determined, separate logistic regressions were conducted to examine whether the resulting profiles significantly differed from each other on study variables. Fourth, separate dummy-coded regressions compared the resulting adolescent polysubstance use profiles among the group of youth with early-onset CU ( $\leq 15$  years), to the groups of youth with later adolescent-onset (16-18 years) and with adult-onset ( $\geq 19$  years) CU, on CU frequency and CAST score at 21 years.

Analyses were conducted in Mplus (version 8.6), using the robust maximum likelihood estimator to account for non-normality. Missing data were handled via full information maximum likelihood, with variables associated with attrition and differences between the present versus the broader QLSCD sample included in analyses. In line with recent recommendations, to account for multiple testing, the  $p$ -value for significance was set to  $p < .005$  and interpreted alongside Bayes factors (BF; Ioannidis, 2018; Keysers, Gazzola, & Wagenmakers, 2020). Bayes factors were approximated using the Bayesian information criterion, which does not require evaluation of prior distributions and is suitable for comparing nested models in large samples (Kass & Raftery, 1995; Wagenmakers, 2007). BF scores of 3.2-10, 10-32, 32-100, and  $>100$  indicate substantial, strong, very strong, and decisive evidence for an association (Jeffreys, 1961). Finally, effect size was examined using Cohen's  $f^2$  measure of local effect size, which is appropriate for use in multivariate regressions, with  $\geq 0.02$ ,  $\geq 0.15$ , and  $\geq 0.35$  indicative of small, medium, and large effects

(Cohen, 1988). Analyses were not pre-registered. Code for analyses are available upon request from the corresponding author.

### **3. Results**

Four participants with early-onset CU (<1%) were missing data on all adolescent substance use variables at age 15 and 17 years and thus were excluded from analyses, resulting in a final analytical sample of  $N=794$ , including  $n=349$  youth with early-onset CU. Eighteen percent of participants in the final analytical sample had some missing data. Eighty-four (11%) participants had missing data on cannabis use (CU) frequency and CAST score at 21 years. Six per cent ( $n=20$ ) and 23% ( $n=81$ ) of the early-onset cannabis use (EOCU) sample had some missing data on substance use at 15 and 17 years, respectively. Participants with missing data were significantly more likely to be male, have an older mother, have divorced/separated parents, and come from a lower socioeconomic status, but did not differ from participants with complete data on any other study variables (see Supplemental Table 2). Table 1 reports sample descriptive statistics and correlations between study variables. At 21 years, 12% of participants ( $n=94$ ) had a CAST score indicative of moderate-to-severe CU disorder, of which  $n=61$  (65%) were youth with early-onset CU (i.e., valid percentage of youth with early-onset CU who had moderate-to-severe CU disorder was 23%). Descriptive statistics for adolescent substance use among youth with early-onset CU are reported in Supplemental Table 3.

#### **3.1. Comparisons Between Youth Groups with Early ( $\leq 15$ years) versus Later Adolescent-Onset (16-18 years) and Adult-Onset ( $\geq 19$ years) Cannabis Use, on Cannabis Outcomes at Age 21 Years**

Results are reported in Table 2. Participants in the early-onset CU group had significantly greater CU frequency and CAST score (21 years), compared to participants in both later adolescent-onset (16-18 years), and adult-onset ( $\geq 19$  years) CU groups. Effect sizes

for these associations were small ( $f^2$  range=0.04-0.07). Participants in the later adolescent-onset CU group did not differ from participants in the adult-onset CU group on frequency or CAST score ( $f^2 < .02$ ; see Supplemental Table 4).

### 3.2. Adolescent Polysubstance Use Profiles Among Youth with Early-Onset Cannabis Use

The Lo–Mendell–Rubin likelihood ratio test indicated the four-profile solution best fit the data. While the AIC, BIC, and sample size adjusted BIC indicated the five-profile solution best fit the data (see Table 3), this solution resulted in a profile with only nine participants, indicating data overextraction. Thus, the four-profile model was determined to be the best solution for the data given it was favored by the Lo–Mendell–Rubin likelihood ratio test, had acceptable classification quality (entropy=.83), and provided a more parsimonious solution with robust profile sizes (lowest  $n=45$ ), compared to the five-profile model. Finally, residual correlations between substance use variables in the four-profile solution were all low to moderate (i.e.,  $< .50$ ), indicating the RMLPA local independence assumption was met.

Mean cannabis, alcohol, and cigarette use, and probability of other substance use at 15 and 17 years, for each of the four profiles are depicted in Figure 1. The first and largest profile comprised adolescents who reported <monthly alcohol use, used cannabis once, reported no cigarette use in the past 12 months, and were very unlikely to report other substance use at both 15 and 17 years (referred to as the **light** profile;  $n=188$ , 54%). The second profile comprised of adolescents who reported an increase in all substance use between 15 and 17 years (referred to as the **escalating** profile;  $n=45$ , 13%). Namely, the escalating profile went from <monthly cannabis and alcohol use, and lifetime (but not past 12 month) cigarette use at 15 years, to weekly CU and cigarette use, and monthly alcohol use at 17 years. This profile also reported the greatest increase in probability of other substance use.

The third profile comprised adolescents who engaged in monthly cannabis and alcohol use at both 15 and 17 years, with no cigarette use in the past 12 months, and had the highest probability of other substance use at 17 years (referred to as the **frequent (-cigarettes)** profile;  $n=50$ , 14%). Finally, the fourth profile comprised of adolescents who reported >weekly CU and cigarette use and around monthly alcohol use at both time points, with relatively stable probability of other substance use (referred to as the **frequent (+cigarettes)** profile;  $n=66$ , 19%).

Differences between the four profiles are reported in Table 4. The light use profile had significantly lower CU frequency and CAST score (21 years), compared to the frequent (+cigarettes) profile. Additionally, the light use profile also had significantly lower CU frequency, compared to the frequent (-cigarettes) profile. Further, the light use and frequent (-cigarettes) profiles came from a higher socioeconomic status than the other two profiles, while the light use and frequent (-cigarettes) profiles were significantly more likely to be studying (21 years), than the frequent (+cigarettes) profile. Finally, the light use profile was significantly more likely to be studying and employed (21 years), than the escalating profile.

### **3.3. Comparisons Between the Different Adolescent Polysubstance Use Profiles Among Youth with Early-Onset Cannabis Use ( $\leq 15$ years), versus Later Adolescent-Onset (16-18 years) and Adult-Onset ( $\geq 19$ years) Cannabis Use Groups, on Emerging Adult Cannabis Use Outcomes (21 years)**

Youth in the early-onset CU group who followed a frequent (-cigarettes), escalating, or frequent (+cigarettes) profile, had greater CU frequency (21 years), compared to youth in the later adolescent-onset (16-18 years) or adult-onset (>19 years) CU groups (Cohen's  $f^2$  range=.02 to .09). Additionally, youth in the early-onset CU group who followed an escalating profile had a greater CAST score (21 years), than youth in the later adolescent-onset (16-18 years; Cohen's  $f^2$ =.02) or adult-onset (>19 years; Cohen's  $f^2$ =.05) CU groups.

Similarly, youth in the early-onset CU group who followed a frequent (+cigarettes) profile in adolescence, had had a greater CAST score (21 years), than youth in the later adolescent-onset (16-18 years; Cohen's  $f^2=.06$ ) or adult-onset (>19 years; Cohen's  $f^2=.12$ ) CU groups. Conversely, while youth in the early-onset CU group who followed a frequent (-cigarettes) profile did not significantly differ from youth with later adolescent-onset CU (16-18 years) on CAST score (21 years), they had significantly greater CAST score compared to the adult-onset (>19 years) CU group (Cohen's  $f^2=.05$ ). Finally, despite not being associated with greater CU frequency, youth in the early-onset CU group who followed a light use profile in adolescence had a greater CAST score (21 years), compared to youth in the adult-onset (>19 years) CU group (Cohen's  $f^2=.03$ ).

#### **4. Discussion**

The present study examined: (1) the different profiles of adolescent polysubstance use among youth with early-onset CU ( $\leq 15$  years); and (2) whether CU outcomes in early adulthood were best explained by early-onset CU alone, or by the resulting polysubstance use profiles found among youth with early-onset CU. Results revealed four separate adolescent polysubstance use profiles, among youth with early-onset CU, reflecting: (1) light; (2) frequent (-cigarettes); (3) escalating; and (4) frequent (+cigarettes) use. The resulting profiles found among youth with early-onset CU were differentially associated with CU frequency and related problems at 21 years.

Youth with early-onset CU who followed a frequent (+cigarettes) polysubstance use profile in adolescence had greater problem CU in emerging adulthood, compared to both the later adolescent-onset (16-18 years) and adult-onset ( $\geq 19$  years) CU groups, with effect sizes pointing to small-to-medium effects. Conversely, youth with early-onset CU who followed a light polysubstance use profile in adolescence only differed to the adult-onset ( $\geq 19$  years) CU group (but not the later adolescent-onset (16-18 years) CU group), on problem CU in

emerging adulthood; however, given the effect size for the difference between light polysubstance use profile and adult-onset ( $\geq 19$  years) CU group was small (Cohen's  $f^2 = .03$ ) and given time since CU onset is a significant predictor of problem CU (Han et al., 2019), future research is needed to examine whether this difference holds later in emerging adulthood and beyond. Ultimately, present findings indicate that treating youth with early-onset CU ( $\leq 15$  years) as a single homogenous group may be an oversimplification that conflates distinct groups with differing risk for future problem CU. While similar arguments have been made in the alcohol literature (Kuntsche, Rossow, Engels, & Kuntsche, 2016), the present study extends this notion to CU.

Present findings also extend existing research by highlighting that rather than occurring in isolation, CU among youth with early-onset CU generally occurs within a polysubstance use context. This is in line with the high level of polysubstance use found among adolescents who use cannabis more broadly (regardless of age of onset; Cho, Stone, & Leventhal, 2019; Merrin et al., 2018; Tomczyk et al., 2016; Zuckermann et al., 2019). Further, present findings build on results of several previous studies (Agrawal et al., 2011; Fairman, 2015; Lipperman-Kreda et al., 2017; Lopez-Quintero & Anthony, 2015; Lopez-Quintero et al., 2018), by indicating that even among youth with early-onset CU, those who engage in more frequent patterns of polysubstance use (in particular, cannabis and cigarette use), report the highest levels of problem CU later in life. Furthermore, while the light use profile differed to the frequent (-cigarettes) profile, it did not differ from the escalating profile, in terms of CU frequency in emerging adulthood. This finding highlights the importance of delaying the onset of *regular* cannabis and other substance use among youth with early-onset CU, as this appears to have an important impact on reducing the frequency of CU in emerging adulthood. Taken together, these findings highlight the differential risk of

developing problem CU among youth with early-onset CU, depending on adolescent polysubstance use profiles.

#### **4.1. Strengths and Limitations**

The present study has several strengths including the large, community sample and prospective assessment of early-onset CU and adolescent substance use, which decreases potential limitations associated with retrospective reports, including recall bias. Another strength is that analyses controlled for sex, socioeconomic status, family composition, prenatal alcohol exposure, and adult social roles, which are differentially associated with cannabis and other substance use among youth (Duko et al., 2022; Keyzers et al., 2020; Schulenberg et al., 2018; Snyder & Merritt, 2015; Staff et al., 2010; Stone et al., 2012).

Nonetheless, the current study has some limitations. The biennial assessment of CU between 13 and 15 years means that youth who used cannabis at 14 years or those who used cannabis  $\leq 11$  years (but not 12, 13, or 15 years), were not categorized in the early-onset CU group. However, the percentage of early-onset CU participants in the current study is in line with other studies conducted in Canadian and US youth (Merrin et al., 2021; Moss et al., 2014; Swift et al., 2008), thus increasing confidence that a majority of youth with early-onset CU were accurately identified in this sample. Further, although self-reported substance use measures may be susceptible to bias, our measures showed good internal consistency and the validity and reliability of substance use reports obtained from youth via confidential surveys is supported (Boykan et al., 2019; Simons, Wills, Emery, & Marks, 2015). While the present study is restricted by small cell sizes, future research should examine whether differences between the different profiles among youth with early-onset CU and later CU onset on CU outcomes in emerging adulthood are moderated by sex, given sex is differentially associated with substance use and addiction (Dir & Hulvershorn, 2019).

Further, while the present study defined adult-onset CU as  $\geq 19$  years (mean age of CU onset and legal age of cannabis consumption in most Canadian provinces), the legal age of cannabis consumption in Québec is 21 years. Thus, future research should examine how the polysubstance use profiles found among the early-onset CU group, compare to youth with adult-onset CU ( $\geq 21$  years), on problem CU later in adulthood. Finally, the current study did not examine CU quantity or potency, which have been associated with increased risk of problem CU (Freeman & Winstock, 2015; Hines et al., 2020). These variables should be explored in future research, especially given the wide variation in potency of cannabis products (Chandra et al., 2019).

## **5. Conclusions**

More than one in two youth with early-onset CU used cannabis and other substances infrequently in adolescence (i.e., light use profile). In turn, youth with early-onset CU in the light use profile had significantly lower CU frequency and problems in emerging adulthood, than youth with early-onset CU who followed a frequent (+cigarettes) profile. Furthermore, youth with early-onset CU who followed an escalating or frequent (+cigarettes) profile in adolescence had greater problem CU than both the later-adolescent and adult-onset CU groups; however, youth in the early-onset CU group who followed a light or frequent (-cigarettes) profile only differed to the adult-onset ( $\geq 19$  years) CU group (but not the later adolescent-onset (16-18 years) CU group), on problem CU in emerging adulthood. In summary, where possible, researchers and clinicians should consider the adolescent polysubstance use patterns among youth with early-onset CU, to better characterize this heterogenous group and effectively allocate resources to the most at-risk youth.



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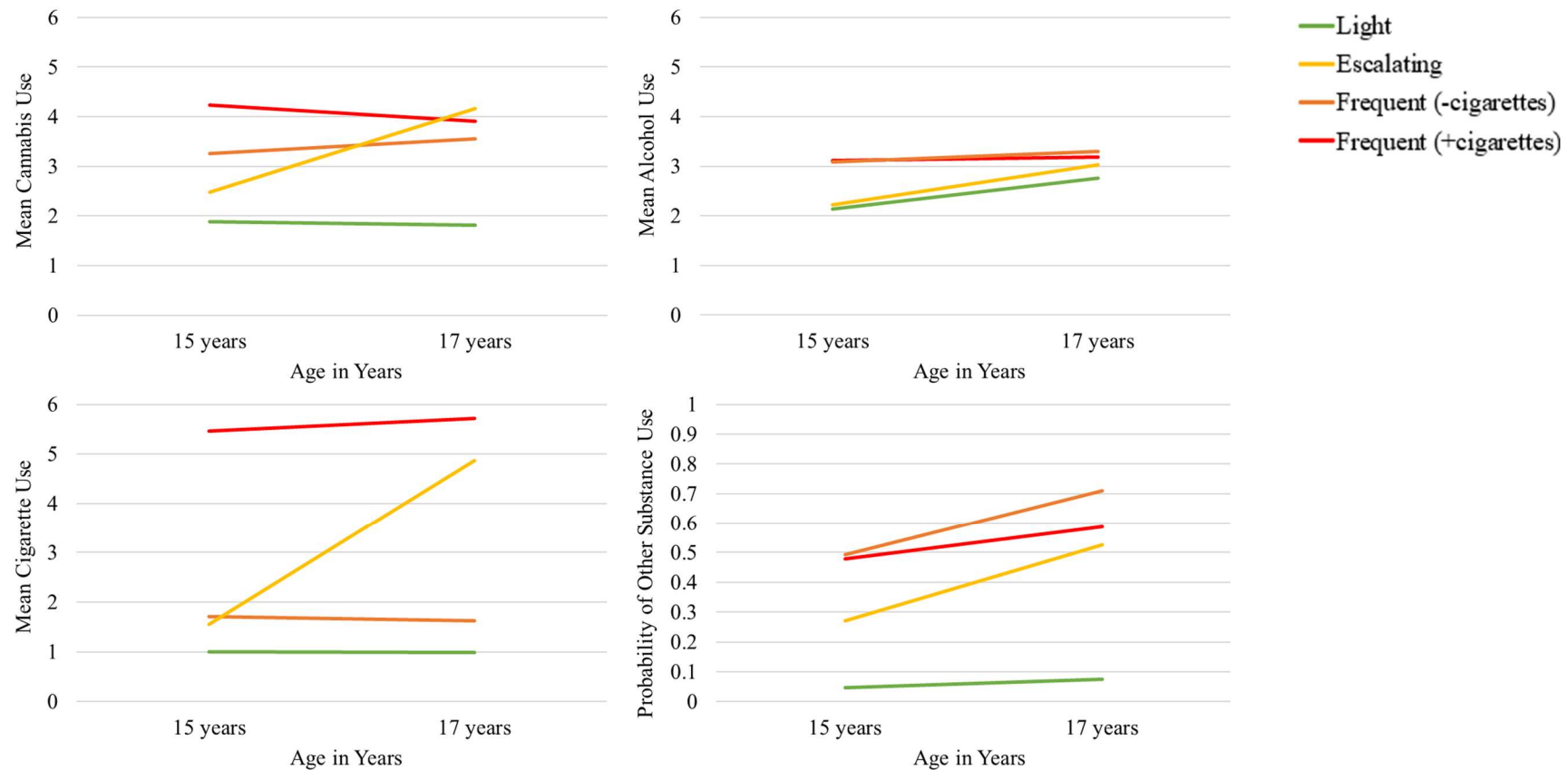
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**Figure 1**

Means for Each Substance Use Variable and Probability of Other Substance Use in the Four- Profile Repeated Measures Latent Profile Analysis for Youth with Early-Onset Cannabis Use ( $\leq 15$  years;  $n=349$ ).



*Note.* Cannabis and alcohol use response options: 0(never) 1(just once to try) 2(<monthly/occasionally) 3(monthly) 4(weekends or 1-2 times per week) 5( $\geq 3$  times per week but not everyday) 6(everyday). Cigarette use response options: 0(never in lifetime) 1(lifetime smoking, but not in past 12 months) 2(occasionally) 3(monthly) 4(weekends or 1-2 times per week) 5( $\geq 3$  times per week but not everyday) 6(everyday). Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2019), ©Gouvernement du Québec, Institut de la statistique du Québec.



Table 1  
 Sample Descriptive Statistics and Correlations Between Study Variables (N=794)

	1	2	3	4	5	6	7	8	9	10	11	
1. CAST (21 years)	1.00	.76	-.17	-.01	-.14	-.10	-.06	.02	-.19	-.01	.24	
2. CU frequency (21 years)		1.00	-.15	.01	-.09	-.04	-.02	.02	-.10	.02	.19	
3. Female			1.00	-.05	-.01	-.01	.01	.09	.09	.03	-.02	
4. Prenatal alcohol exposure				1.00	.18	.20	.04	-.02	.07	-.06	-.04	
5. Socioeconomic status (5 months)					1.00	.47	.27	-.19	.35	-.05	-.21	
6. Mother's age						1.00	.21	-.13	.15	-.04	-.10	
7. Family composition <sup>a</sup> (12 years)							1.00	-.09	.14	.00	-.28	
8. Lives independently (21 years)								1.00	-.12	-.09	.10	
9. Studying (21 years)									1.00	-.07	-.16	
10. Employed (21 years)										1.00	.07	
11. Early-onset CU ( $\leq 15$ years)											1.00	
	<i>M/ valid %</i>	2.21	2.10	56	1.60	0.13	29.71	56	49	61	79	44
	<i>SD/ n</i>	3.97	1.91	447	0.86	0.95	5.12	447	296	440	567	349

*Note.* CAST=Cannabis abuse screening test. CU=Cannabis use. Early-onset CU=Early-onset cannabis use. M=Mean.SD=standard deviation.  
<sup>a</sup>0=Not intact; 1=Intact. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2019),  
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Table 2

Comparisons Between Youth with Early-Onset (<15 years), Later Adolescent-Onset (16-18 years), and Adult-Onset (>19 years) Cannabis Use, on Cannabis Outcomes at 21 Years

Parameter	Cannabis Use Frequency				Problem Cannabis Use (CAST)			
	$\beta$ (SE)	95%CI	$p$	BF	$\beta$ (SE)	95%CI	$p$	BF
<b>Early-onset CU vs Later Adolescent-Onset Cannabis Use (16-18 years; <math>n=708</math>):</b>								
Female	<b>-0.18 (0.04)</b>	<b>[-0.26, -0.1]</b>	<b>&lt;.001</b>	<b>&gt;100</b>	<b>-0.18 (0.04)</b>	<b>[-0.26, -0.11]</b>	<b>&lt;.001</b>	<b>&gt;100</b>
Prenatal alcohol exposure	0.02 (0.04)	[-0.06, 0.09]	.628	0.04	0.02 (0.04)	[-0.06, 0.09]	.685	0.04
SES	0.03 (0.05)	[-0.06, 0.13]	.505	0.05	-0.04 (0.05)	[-0.13, 0.05]	.415	0.05
Family composition <sup>a</sup>	-0.05 (0.05)	[-0.15, 0.04]	.286	0.07	-0.05 (0.05)	[-0.15, 0.04]	.282	0.07
Mother's age	0.04 (0.04)	[-0.04, 0.13]	.324	0.06	0.04 (0.04)	[-0.04, 0.12]	.334	0.06
Lives independently	0.01 (0.05)	[-0.08, 0.1]	.812	0.04	-0.01 (0.05)	[-0.1, 0.08]	.792	0.04
Currently studying	-0.05 (0.04)	[-0.14, 0.03]	.219	0.08	<b>-0.13 (0.04)</b>	<b>[-0.21, -0.05]</b>	<b>.002</b>	<b>4.41</b>
Employed	0.01 (0.04)	[-0.08, 0.09]	.871	0.04	-0.06 (0.04)	[-0.14, 0.03]	.207	0.1
Early-onset CU	<b>0.18 (0.04)</b>	<b>[0.1, 0.26]</b>	<b>&lt;.001</b>	<b>&gt;100</b>	<b>0.2 (0.04)</b>	<b>[0.12, 0.28]</b>	<b>&lt;.001</b>	<b>&gt;100</b>
<b>Early-onset CU vs Adult-Onset Cannabis Use (&gt;19 years; <math>n=435</math>):</b>								
Female	<b>-0.16 (0.05)</b>	<b>[-0.26, -0.06]</b>	<b>.002</b>	<b>4.7</b>	<b>-0.2 (0.05)</b>	<b>[-0.29, -0.1]</b>	<b>&lt;.001</b>	<b>58.64</b>
Prenatal alcohol exposure	0.02 (0.05)	[-0.09, 0.12]	.759	0.05	0.03 (0.05)	[-0.07, 0.12]	.591	0.05
SES	0.07 (0.07)	[-0.07, 0.2]	.325	0.08	-0.05 (0.07)	[-0.18, 0.08]	.437	0.06
Family composition <sup>a</sup>	-0.12 (0.07)	[-0.25, 0.01]	.066	0.24	-0.09 (0.07)	[-0.22, 0.04]	.185	0.12
Mother's age	0.05 (0.05)	[-0.05, 0.16]	.307	0.08	0.06 (0.05)	[-0.04, 0.15]	.234	0.09
Lives independently	-0.02 (0.06)	[-0.13, 0.1]	.777	0.05	-0.07 (0.06)	[-0.18, 0.05]	.242	0.09
Currently studying	0.02 (0.06)	[-0.09, 0.12]	.757	0.05	-0.09 (0.05)	[-0.19, 0.01]	.068	0.21
Employed	0.05 (0.05)	[-0.05, 0.15]	.344	0.08	0.04 (0.05)	[-0.07, 0.14]	.497	0.06
Early-onset CU	<b>0.18 (0.04)</b>	<b>[0.1, 0.26]</b>	<b>&lt;.001</b>	<b>21.37</b>	<b>0.24 (0.03)</b>	<b>[0.18, 0.3]</b>	<b>&lt;.001</b>	<b>&gt;100</b>

Note. Significant effects at  $p < .005$ , with Bayes factor (BF)  $> 3$  are bolded. Early-onset CU=Early-onset cannabis use. CAST=Cannabis Abuse Screening Test. SE=Standard error. CI=Confidence interval. <sup>a</sup>0=Not intact; 1=Intact. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2019), ©Gouvernement du Québec, Institut de la statistique du Québec.

Table 3

Fit and Entropy Statistics for the Repeated Measures Latent Profile Analysis Examining Polysubstance Use in Adolescence, Among Youth With Early-Onset CU ( $\leq 15$  years;  $n=349$ )

	2 Profile	3 Profile	4 Profile	5 Profile
AIC	7207.63	7049.92	6952.84	6889.02
BIC	7296.30	7173.29	7110.90	7081.77
SSA BIC	7223.33	7071.77	6980.84	6923.16
LMR LRT $p$	.000	.002	.093	.061
Entropy	0.90	0.89	0.83	.86

*Note.* AIC= Akaike information criterion. BIC=Bayesian information criterion. SSA BIC = Sample size adjusted Bayesian information criterion. LMR LRT= Lo-Mendell-Rubin likelihood ratio test. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2019), ©Gouvernement du Québec, Institut de la statistique du Québec.

Table 4

Descriptive Statistics for Each Polysubstance Use Profile Found Among Adolescents with Early-Onset Cannabis Use ( $N=349$ )

Variables	A: Light Use ( $n=188$ ; 54%)	B: Escalating ( $n=45$ ; 13%)	C: Frequent (-cigarettes) ( $n=50$ ; 14%)	D: Frequent (+cigarettes) ( $n=66$ ; 19%)
	<i>M/ valid % (SD/ n)</i>	<i>M/ valid % (SD/ n)</i>	<i>M/ valid % (SD/ n)</i>	<i>M/ valid % (SD/ n)</i>
CAST Score (21 years)	2.46 (4.04) <sup>D</sup>	4.14 (5)	3.73 (5.18)	5.76 (5.8)
Cannabis use frequency (21 years)	2.15 (2.02) <sup>C,D</sup>	2.89 (2.27)	2.9 (2.12)	3.36 (2.51)
Socioeconomic status	0 (0.91) <sup>B,D</sup>	-0.36 (0.89)	0.09 (0.92) <sup>B,D</sup>	-0.31 (0.89)
Prenatal alcohol exposure	1.58 (0.7)	1.4 (0.62)	1.54 (0.99)	1.67 (0.9)
Family composition <sup>a</sup>	43% (80)	47% (21)	40% (20)	30% (20)
Mother's age	29.19 (5.57)	29.64 (5.41)	28.99 (5.67)	28.34 (5.48)
Female	57% (107)	58% (26)	62% (31)	44% (29)
Lives independently	58% (72)	40% (12)	61% (20)	59% (20)
Studying	59% (88) <sup>B,D</sup>	38% (14)	57% (24) <sup>D</sup>	30% (14)
Employed	87% (130) <sup>B</sup>	73% (27)	83% (35)	76% (34)

*Note.* Superscript indicates a significant difference ( $p<.05$ ) with that group. CAST=Cannabis Abuse Screening Test. M=Mean. SD=Standard deviation.

<sup>a</sup>0=Not intact; 1=Intact. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2019),

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Table 5

Comparisons Between Adolescent Polysubstance Use Profiles Among Adolescents with Early-Onset Cannabis Use, and Later Adolescent-Onset (16-18 years) and Adult-Onset ( $\geq 19$  years) Cannabis Use, on Cannabis Outcomes at 21 Years

Parameter	Cannabis Use Frequency				Problem Cannabis Use (CAST)			
	$\beta$ (SE)	95%CI	<i>p</i>	BF	$\beta$ (SE)	95%CI	<i>p</i>	BF
<u>Later Adolescent-Onset Cannabis Use (16-18 years; <i>n</i>=359 years)</u>								
Female	<b>-0.19 (0.04)</b>	<b>[-0.26, -0.11]</b>	<b>.000</b>	<b>&gt;100</b>	<b>-0.19 (0.04)</b>	<b>[-0.26, -0.11]</b>	<b>&lt;.001</b>	<b>&gt;100</b>
Prenatal alcohol exposure	0.02 (0.04)	[-0.06, 0.1]	.628	0.04	0.02 (0.04)	[-0.06, 0.09]	.689	0.04
SES	0.03 (0.05)	[-0.06, 0.12]	.544	0.04	-0.05 (0.05)	[-0.14, 0.05]	.329	0.06
Family composition	-0.05 (0.05)	[-0.14, 0.05]	.349	0.06	-0.04 (0.05)	[-0.13, 0.05]	.378	0.06
Mother's age	0.05 (0.04)	[-0.03, 0.13]	.241	0.08	0.05 (0.04)	[-0.03, 0.13]	.223	0.08
Lives independently	0.02 (0.05)	[-0.07, 0.11]	.597	0.04	0 (0.04)	[-0.08, 0.09]	.957	0.04
Currently studying	-0.03 (0.04)	[-0.12, 0.05]	.476	0.05	-0.1 (0.04)	[-0.18, -0.02]	.012	0.82
Employed	0.02 (0.04)	[-0.06, 0.1]	.608	0.04	-0.04 (0.04)	[-0.13, 0.05]	.381	0.06
Polysubstance Use Patterns:								
Light	0.07 (0.04)	[-0.02, 0.15]	.105	0.15	0.09 (0.04)	[0.01, 0.17]	.027	0.36
Escalating	<b>0.13 (0.05)</b>	<b>[0.04, 0.22]</b>	<b>.004</b>	<b>7.26</b>	<b>0.14 (0.05)</b>	<b>[0.04, 0.23]</b>	<b>.005</b>	<b>11.65</b>
Frequent (-cigarettes)	<b>0.14 (0.04)</b>	<b>[0.06, 0.23]</b>	<b>.001</b>	<b>16.02</b>	0.13 (0.05)	[0.04, 0.23]	.008	7.99
Frequent (+cigarettes)	<b>0.22 (0.06)</b>	<b>[0.11, 0.33]</b>	<b>&lt;.001</b>	<b>&gt;100</b>	<b>0.26 (0.06)</b>	<b>[0.14, 0.38]</b>	<b>.000</b>	<b>&gt;100</b>
<u>Adult-Onset Cannabis Use (&gt;19 years; <i>n</i>=86 years)</u>								
Female	<b>-0.17 (0.05)</b>	<b>[-0.27, -0.07]</b>	<b>.001</b>	<b>7.98</b>	<b>-0.2 (0.05)</b>	<b>[-0.29, -0.1]</b>	<b>&lt;.001</b>	<b>&gt;100</b>
Prenatal alcohol exposure	0.02 (0.05)	[-0.09, 0.12]	.746	0.05	0.03 (0.05)	[-0.07, 0.12]	.568	0.06
SES	0.06 (0.06)	[-0.07, 0.18]	.357	0.07	-0.07 (0.06)	[-0.19, 0.06]	.288	0.08
Family composition <sup>a</sup>	-0.1 (0.06)	[-0.23, 0.02]	.091	0.17	-0.07 (0.06)	[-0.19, 0.06]	.291	0.08
Mother's age	0.07 (0.05)	[-0.03, 0.17]	.189	0.11	0.08 (0.05)	[-0.02, 0.17]	.106	0.15
Lives independently	0 (0.06)	[-0.11, 0.11]	.998	0.05	-0.05 (0.06)	[-0.16, 0.06]	.367	0.07
Currently studying	0.06 (0.05)	[-0.05, 0.16]	.278	0.08	-0.05 (0.05)	[-0.15, 0.05]	.346	0.07
Employed	0.07 (0.05)	[-0.03, 0.17]	.175	0.13	0.06 (0.05)	[-0.05, 0.16]	.276	0.1
Polysubstance Use Patterns:								
Light Use	0.13 (0.05)	[0.02, 0.23]	.020	0.29	<b>0.2 (0.04)</b>	<b>[0.12, 0.28]</b>	<b>&lt;.001</b>	<b>7.59</b>
Escalating	<b>0.2 (0.06)</b>	<b>[0.08, 0.32]</b>	<b>.001</b>	<b>13.36</b>	<b>0.24 (0.06)</b>	<b>[0.12, 0.35]</b>	<b>&lt;.001</b>	<b>&gt;100</b>
Frequent (-cigarettes)	<b>0.21 (0.06)</b>	<b>[0.1, 0.32]</b>	<b>&lt;.001</b>	<b>26.87</b>	<b>0.23 (0.06)</b>	<b>[0.12, 0.34]</b>	<b>&lt;.001</b>	<b>&gt;100</b>
Frequent (+cigarettes)	<b>0.32 (0.07)</b>	<b>[0.18, 0.45]</b>	<b>&lt;.001</b>	<b>&gt;100</b>	<b>0.4 (0.07)</b>	<b>[0.27, 0.53]</b>	<b>&lt;.001</b>	<b>&gt;100</b>

Note. Significant effects at  $p < .005$ , with Bayes factor  $\geq 3$  are bolded. CAST=Cannabis Abuse Screening Test. SES=Socioeconomic status. SE=Standard error. CI=Confidence interval. BF=Bayes Factor. <sup>a</sup>0=Not intact; 1=Intact. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2019), ©Gouvernement du Québec, Institut de la statistique du Québec.