



Early cannabis initiation: Substance use and mental health profiles of service-seeking youth

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ABSTRACT

Introduction: Early cannabis use is associated with mental health and substance use (MHSU) challenges into adulthood. Given the vulnerability of youth who use cannabis, it is important to understand their clinical profiles and markers of risk. This cross-sectional descriptive study examines youth who began using cannabis during early adolescence compared to those who initiated at an older age.

Methods: 634 youth and emerging adults (age $M = 19.5$, $SD = 2.3$; 46.5% female) were assessed at intake in a Canadian youth mental health and concurrent disorder out-patient service. Measures of demographic characteristics and MHSU were compared for youth who initiated cannabis use under the age of 14 versus 14 years or over.

Results: Nearly 30% of youth initiated cannabis use before age 14. Those who initiated cannabis early were younger and had distinct psychosocial risk factors. They were more likely to use cannabis ($p = .005$), tobacco ($p = .006$), powder cocaine ($p = .030$), and/or benzodiazepines ($p = .033$) at a high frequency. If they used other substances, they were more likely to have begun using them younger (all $p < .001$). Early initiators had more externalizing mental health symptoms ($p = .024$), crime/violence concerns ($p < .001$), and past trauma ($p = .001$).

Conclusions: Distinct, clinically meaningful differences emerged between youth who initiated cannabis use early versus later. Early cannabis use is associated with multiple, overlapping needs. Cannabis use and concurrent MHSU should be systematically assessed from an early age, and prevention/promotion efforts should take early onset into account.

1. Introduction

The prevalence of cannabis use among adolescents in Canada is one of the highest in the world, with nearly a quarter of 15 year olds reporting having used cannabis at some point in their lives (World Health Organization, 2016). In the province of Ontario, cannabis remains the most commonly used drug among students in grades 7–12, with one in five students reporting past year use of cannabis and 2% reporting symptoms of cannabis dependence (grades 9–12) (Boak, Hamilton, Adlaf, & Mann, 2015). Cannabis has the shortest duration from first use to dependence, and earlier onset of use presents an elevated risk for developing dependence (Behrendt, Wittchen, Höfler, Lieb, & Beesdo, 2009). The mean age of onset for dependence in youth is between ages 15–18 (Behrendt

Abbreviations: MHSU, Mental Health and Substance Use

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et al., 2009). Early and frequent cannabis use among Canadian youth is cause for concern, as both early initiation and frequency of use are important factors contributing to the transition from recreational use to cannabis use disorder (CUD) (Behrendt et al., 2009; Chen, Storr, & Anthony, 2009; Shedler & Block, 1990; Silins et al., 2014; Winters & Lee, 2008).

The age of cannabis initiation is of critical importance in understanding the path from recreational to problematic use. The risk of transitioning from early initiation of substance use to substance use disorders has been shown to increase incrementally with the time since first exposure; this risk interacts with mental health challenges, which puts the most vulnerable early initiators at higher risk for a substance use disorder during adolescence (Behrendt et al., 2012; Sung, Erkanli, Angold, & Costello, 2004). Mental health challenges, trauma and stress are also associated with cannabis use (Blanco et al., 2014; Carliner et al., 2016; Copeland, Rooke, & Swift, 2013).

Early adolescence is a critical period of neurodevelopment, with synaptic pruning and increased myelination occurring (Paus, 2005). These processes are essential for the optimal development of cognitive, emotional, motivational and sensorimotor functions (Lubman, Yücel, & Hall, 2007). This makes early adolescence a particularly vulnerable period for cannabis use. Early onset of cannabis use among adolescents (13–14 years of age) has been shown to be associated with cognitive impairment, e.g., a decline in verbal IQ and a deterioration of working memory and attention (Castellanos-Ryan et al., 2017). In a similar vein, early cannabis use is also associated with poor school performance and leaving school early, which may be partially due to negative cognitive effects and/or early cannabis use youth developing connections with youth who use substances or have behavioral issues of concern (Grant & Bélanger, 2017; Lynskey & Hall, 2000).

Despite having knowledge that early initiation greatly increases the probability of developing CUD, less is known about the occurrence of other substance use risk factors (e.g. frequency of use, polysubstance use, comorbid mental health conditions, trauma etc.) and how these may contribute to the development of problematic cannabis use in early initiators. Findings from several longitudinal and cross-sectional studies show that adolescent cannabis use is related to the development of acute psychotic symptoms and later-life psychotic disorders (Casadio, Fernandes, Murray, & Di Forti, 2011; Semple, McIntosh, & Lawrie, 2005), with those using at higher frequency (Moore et al., 2007), and/or those with earlier initiation of cannabis use at highest risk (Arseneault et al., 2002; Wilkinson, Radhakrishnan, & D'Souza, 2014). With respect to internalizing disorders, a large prospective study of young adults found that cannabis use before 15 years of age was significantly associated with anxiety and depression, independent of confounding factors such as gender, family income, maternal mental health, maternal smoking, alcohol use, etc. However, the study could not determine the directionality of the effect (Hayatbakhsh et al., 2007). Youth experiencing childhood maltreatment, which often precedes mental health challenges such as internalizing disorders (Bolger & Patterson, 2001), were more likely to initiate cannabis before the age of 17 (Mills, Kisely, Alati, Strathearn, & Najman, 2017). However, much less is known about the association between exposure to other forms of trauma and early cannabis use, despite established associations between trauma, mental health, and substance use, and despite the use of cannabis to self-medicate symptoms of post-traumatic stress disorder (Orsolini et al., 2019). Cannabis use during adolescence and young adulthood (15–21 years of age) has also been shown to be associated with use of illicit drugs, e.g., cocaine, opiates, sedatives, stimulants etc. However, the directionality of other drug use in relation to cannabis use is not clearly understood (Fergusson & Horwood, 2000), and may be more nuanced when accounting for association with different profiles of comorbid mental health conditions (Degenhardt et al., 2009), particularly among those who initiate cannabis use at an earlier age.

The Ontario Student Drug Use and Health Survey identified age 14 as a key age of increase in cannabis use (Boak, Hamilton, Adlaf, & Mann, 2017). Despite this increase, our team found that among younger youth (age 12–13 on average and prior to the transition to secondary school), 2.4% and 5.6% of students respectively reported cannabis use, while 7.5% reported some degree of substance use challenge (Brownlie et al., 2018). Another study found that the earlier the cannabis onset measured at ages 13 through 17, the greater the risk of substance abuse in adulthood (Rioux et al., 2018); however, this study would have missed those initiating cannabis use at the earliest ages, with the highest vulnerability. Another recent study showed that consistently high frequency cannabis use over the course of adolescence is associated with greater challenges in young adulthood in terms of other substance use challenges, as well as life satisfaction, academic/professional achievement (Grevenstein & Kröninger-Jungaberle, 2015); again, assessment began at age 14, missing earlier onset experiences. This raises the importance of gaining a more in-depth understanding of the profiles of the youth who begin using cannabis and other substances at an early age.

In the absence of effective prevention and early intervention efforts for younger youth, some youth in this risk-age group will potentially have longer substance-use histories that span across the entire developmental growth period, which may result in more detrimental impacts on neurodevelopmental trajectories and psychosocial outcomes (Ellickson, Martino, & Collins, 2004; Fontes et al., 2011; Silins et al., 2014), potentially further perpetuating use. This risk-age group may also serve as an early warning indicator of an underlying vulnerability to dependence and/or comorbid mental health conditions (e.g. externalizing disorders (Farmer et al., 2015)) that may reinforce progression.

The goal of the current cross-sectional descriptive study is to characterize the risk profiles of youth initiating cannabis at an early age. An early adolescence age distinction of under 14 years was considered clinically meaningful and was purposefully selected to be explored in the current study, as age 14 marks the transition to secondary school provincially and has been identified as a key age of increase (Boak et al., 2017). Given the vulnerability of the youngest cannabis-using youth, understanding their clinical profiles is an essential building block towards understanding developmental trajectories and markers of risk towards cannabis use disorder. This study will thereby provide a more comprehensive exploration of aspects of substance use and comorbid mental health concerns in developing cannabis use profiles among younger youth prior to the transition to secondary school. The results will have implications for the development of more targeted prevention and intervention initiatives that can be specifically tailored to age-risk profiles.

2. Methods

2.1. Participants

The sample for this study consists of youth recruited from an outpatient treatment service at the Youth Addictions and Concurrent Disorder Service at the Centre for Addiction and Mental Health (CAMH) in Toronto, Canada. This service offers treatment for substance use problems with or without concurrent mental health concerns for youth aged 14–24. Youth are referred to the service through various routes, including physician referrals and family or self-referrals. Youth attend an orientation session to introduce them to the services and to conduct an intake assessment, during which they are approached for their consent to participate in research. The study sample is comprised of all youth who attended orientation between 2013 and 2019 and provided consent for the use of their data for research purposes (72.5%). They must also have reported having ever used cannabis and indicated an age of onset for cannabis use (63.7%). This provided a total sample of $N = 634$. The Research Ethics Board of CAMH approved the study.

2.2. Measures

Participants provided demographic information and completed questionnaires regarding mental health and substance use. The demographic form included variables such as age, sex, ethnic background, employment and education status, justice system involvement, and housing situation. All questionnaires were a part of the usual intake assessment at the orientation session and part of ongoing clinical-research collaboration.

Using demographics, we categorized youth on NEET [“not in employment, education, or training”] status, and legal system involvement. NEET categorization identifies youth who are disconnected from employment and education structures, i.e., not engaged in any form of employment, education, or training structures (Social Exclusion Unit, 1999). Precarious/institutional housing status included any participants who indicated living in a rooming or boarding house, group home, foster care, supportive/transitional housing, treatment facility, or shelter, or who were couch surfing or living on the street (Smith, Hawke, Chaim, & Henderson, 2017).

Adolescent Alcohol and Drug Involvement Scale (AADIS). This standardized tool (Moberg, 2003) captures the frequency of substance use by youth ranging from 0 (never used) to 7 (several times a day) and includes 11 substances, i.e. cannabis, tobacco, alcohol, hallucinogens, amphetamines, powder cocaine, rock cocaine, barbiturates, opiates, inhalants, and benzodiazepines (alternate names provided). One question was added to the scale: when youth endorse a substance, they are asked to state the age at which they first used the substance, which constitutes the age-of-onset variable, dichotomized as < 14 or $14+$. In the current analyses, only 8 substances were used; rock cocaine, barbiturates, and inhalants were excluded due to low endorsement rates limiting variability (cell sizes < 5). Cronbach's alpha on the total AADIS scale score in the current sample is .73.

Global Appraisal of Individual Needs - Short Screener (GAIN-SS). The GAIN-Short Screener (Chestnut Health Systems, 2010) version 2.0 was developed based on the GAIN - Initial (Dennis, White, Titus, & Unsicker, 2008) and consists of 20 items screening for scores in four domains: internalizing disorders (e.g., depression: feeling lonely, sad, depressed), externalizing disorders (e.g. ADHD: had a hard time paying attention), substance use disorder (e.g., used alcohol or other drugs weekly or more), and crime/violence concerns (took something from a store without paying for it). It has been shown to have high reliability (Cronbach's alpha = 0.96 for the total screener), high sensitivity (90% or greater) and high specificity (92% or greater) (Dennis, Chan, & Funk, 2006). The items in the GAIN-SS are endorsed based on recency of symptoms, i.e. 0 (never), 1 (more than a year ago), 2 (2–12 months ago) and 3 (past month). For the purposes of the current analyses, past month and 2–12 months were combined to indicate past year symptom endorsement. Each scale score is based on the number of symptoms endorsed in the past year, with scores ranging from 0 to 5. Based on scale standards, a youth is considered to have a high probability for a diagnosis if three or more items in a subscale are endorsed in the past year. In the current study, the GAIN-SS domains were analyzed as continuous scores (0–5) rather than cutoff scores for the likelihood of a diagnosis due to a ceiling effect. With permission from Chestnut Health Systems to the project leads at [BLIND], the GAIN-SS was modified by adding seven items to create a 27 item version that was used in this project. The seven additional items screen for traumatic stress (1 item), distorted thinking (2 items), excessive internet or videogame use (1 item), gambling issues (1 item) and eating concerns (2 items). Cronbach's alpha for the total scale score in the current sample is .86.

Trauma screener. The Trauma History Screen (THS) was used (Carlson et al., 2011). It asks respondents to endorse whether they have ever experienced any of 13 specific forms of traumatic events, including accidents, natural disasters, sexual trauma, bullying, etc., plus one item referring to any “other” type of traumatic event. The test-retest reliability of the exposure to the assessed stressors has been found to be .93 for the total scale score (Carlson et al., 2011). To tailor the tool to an adolescent sample, our team removed an item referring to military trauma and added two items referring to experiencing bullying (one item for bullying in childhood, one for bullying as an adolescent/young adult); other minor adjustments were made to adapt to a youth population (e.g., revising the word “adult” to “adolescent/adult”). The resulting scale had 14 specific items and one ‘other’ item. For the purposes of this study, the trauma variable is defined as the sum of the number of types of trauma to which the participant has been exposed (0–15); analyses were rerun excluding the bullying items given that they are newly added, unvalidated items. Cronbach's alpha for the total scale score in the current sample is .78.

2.3. Analyses

The exposure variable of interest in the current analyses is the age of first use of cannabis, dichotomized as < 14 years of age versus $14+$, followed by age of onset as a continuous variable in the final analyses. Using descriptive statistics, we characterized the

sample on demographic characteristics using chi-square analyses. We conducted the subsequent analyses controlling for sex and duration of use, given that there were duration of use differences between the two groups in association with age and that sex differences are consistently found in cannabis use behaviours (Calakos, Bhatt, Foster, & Cosgrove, 2017; Tu, Ratner, & Johnson, 2008).

We then conducted multiple logistic regression analyses, controlling for sex and duration of use, independently for individual exposure variables, which included each substance use variable (daily/near daily use of substances reported on the AADIS). Cross-tabulations described proportions by age group. We conducted ANCOVAs to analyze the association between cannabis age of onset groups and GAIN-SS domains, controlling for duration of use and sex, with logistic regressions for the GAIN-SS extension items.

We then identified the substances that participants reported most often as the substance first used based on the AADIS-age of onset variable; since almost all participants reported their youngest age of onset for cannabis, tobacco, and/or alcohol, these three substances were further explored. Venn diagrams were drawn using EulerAPE software (Micallef & Rodgers, 2014) to characterize the age of the first substance of use (cannabis, tobacco, alcohol) in the 14+ and < 14 groups, examining age-of-first use percentages for each substance and then age-of-first use percentages for co-occurring substances when there was overlap, with chi-square tests for significance.

Based on the exploratory findings and to expand on the findings for the two dichotomous age groupings, we conducted multiple regression analyses to identify factors uniquely associated with age of first cannabis use as a continuous variable; entered into the model were sex and duration of use in Block 1 as control variables, then in Block 2, each of the primary variables identified as significant in the between-group comparisons (GAIN-SS Externalizing, GAIN-SS Crime/Violence, NEET, legal system involvement, precarious/institutional housing). Collinearity diagnoses demonstrated that none of the variables were highly correlated. Pairwise deletion was used. For multiple comparisons, the False Discovery Rate (FDR) correction was used (Narum, 2006). Statistical analyses were conducted with using SPSS 24.0 (IBM Corp., 2016).

3. Results

3.1. Demographics characteristics

Sociodemographic characteristics are presented in Table 1. Of the 634 youth in the sample, 187 (29.5%) reported that they started using cannabis before the age of 14 (age of onset range 8–13 in the under 14 group, $M = 12.2$, $SD = 1.1$; range 14–21 in the 14+ group, $M = 15.3$, $SD = 1.5$). Those who initiated use in early adolescence were similar to the 14+ cohort on many sociodemographic variables. There were four exceptions. The average age of the two groups differed: those in the < 14 group were seeking services at a younger age compared to the 14+ group (< 14: current age $M = 18.84$, $SD = 2.5$; 14+ current age $M = 19.7$, $SD = 2.2$; $t(604) = 4.276$, $p < .001$). Additionally, participants in the < 14 group were more likely to be NEET (not engaged in employment, education or training, $p = .029$), to have precarious/institutional living arrangements ($p = .004$), and to have been involved in the legal system ($p < .001$).

3.2. Substance use and mental health profiles

The substance use profiles of youth who began using cannabis before versus after age 14 are presented in Table 2, controlling for sex and duration of use. Early initiators did not use a greater number of substances than those who began using later, at $M = 6.7$, $SD = 2.1$ for the under 14 group and $M = 5.9$, $SD = 2.1$ for the 14+ group, $F(1) = 8.167$, $p = .160$. However, they were more likely to use some substances on a daily or near daily basis: cannabis ($p = .005$), tobacco ($p = .006$), powder cocaine ($p = .030$), and benzodiazepines ($p = .033$). For all substances under investigation, age of onset was significantly younger among those who started using cannabis under the age of 14, all at $p < .001$ (Fig. 1).

Nearly all youth reported cannabis, tobacco, or alcohol, or a combination thereof, as their substance of first use (97.2%). From among these three substances, the first used substance is presented in Fig. 2, with concurrent onset of multiple substances in the same year illustrated. Over a quarter of youth in the under 14 group began substance use with cannabis only, while only 12.3% of youth in

Table 1
Demographic variables of participants, based on age of onset of cannabis use.

	Cannabis initiation < 14		Cannabis initiation 14+		Chi-2	p
	N	%	N	%		
Sex % female	78	43.3%	217	50.7%	2.754	0.097
Born in Canada	160	87.0%	370	83.5%	1.173	0.279
White/European	125	67.6%	296	67.4%	0.001	0.972
English as a first language	166	91.2%	400	90.7%	0.040	0.842
NEET	74	41.8%	136	32.5%	4.767	0.029
Government financial support	43	23.5%	83	19.3%	1.416	0.234
Precarious housing	22	11.9%	23	5.4%	8.117	0.004
Legal system involvement	98	68.1%	135	41.0%	29.261	< 0.001

¹ NEET = Not in employment, education, or training.

Table 2

Logistic regression of substance use profiles of youth initiating cannabis use under the age of 14 versus age 14 and over, controlling for sex and duration of use.

Daily/near daily use	Cannabis initiation < 14		Cannabis initiation 14+		B	Wald Chi ²	p	OR (95% CI)
	N	%	N	%				
Cannabis	149	80.1%	306	68.6%	0.664	7.926	0.005	1.943 (1.224, 3.086)
Tobacco	145	79.7%	267	61.1%	0.641	7.545	0.006	1.898 (1.201, 2.998)
Alcohol	79	43.4%	147	33.6%	-0.050	0.055	0.814	0.951 (0.626, 1.445)
Hallucinogens	9	5.1%	16	3.7%	-0.240	0.220	0.639	0.787 (0.289, 2.145)
Amphetamines	18	10.3%	31	7.2%	0.321	0.803	0.370	1.379 (0.683, 2.785)
Powder cocaine	40	22.1%	40	9.2%	0.619	4.734	0.030	1.857 (1.063, 3.244)
Opiates	17	9.6%	19	4.4%	0.293	0.528	0.467	1.340 (0.608, 2.954)
Benzodiazepines	24	13.9%	24	5.6%	0.746	4.556	0.033	2.109 (1.063, 4.184)

Note. FDR corrected alpha = 0.0184.

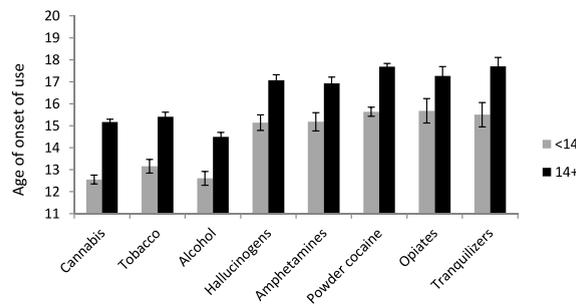


Fig. 1. Age of onset of the use of various substances, based on initiation of cannabis use at under 14 years of age versus at age 14 or over; analysis of covariance, controlling for age and sex; error bars represent 95% confidence intervals. FDR-corrected alpha = .0184.

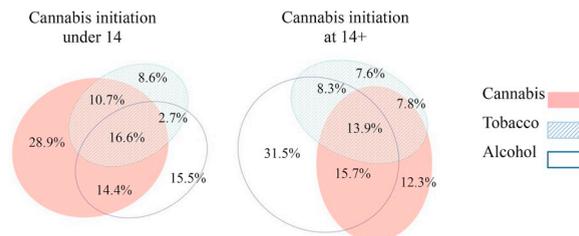


Fig. 2. Substance of first use as reported by participants, for youth who initiated cannabis under the age of 14 versus at 14 or over.

the 14+ group began with only cannabis, which is significant with control variables (Wald $\chi^2 = 20.889, p < .001$). Conversely, only 15.5% of youth in the under 14 group began substance use with alcohol only, versus nearly a third of those in the 14+ group (Wald $\chi^2 = 10.116, p = .001$). While single-substance onset differed across the two groups, concurrent-onset poly-substance use represented a similarly substantial proportion of youth in both groups (41.7% in < 14 and 37.4% in 14+; Wald $\chi^2 = .084, p = .772$).

The mental health profiles of the two groups are presented in Table 3. While internalizing symptoms ($p = .219$) and substance use disorder symptoms ($p = .639$) were similarly high across the two groups, externalizing disorder symptoms ($p = .024$) and crime/

Table 3

Analysis of covariance on GAIN-Short Screener subscreener total scores based on initiation of cannabis use at under 14 years of age versus at age 14 or over, controlling for sex and duration of use.

	Cannabis initiation < 14			Cannabis initiation 14+			F(1)	p	η^2
	N	EMM	SE	N	EMM	SE			
Internalizing disorder	166	4.12	0.09	407	4.26	0.06	1.511	0.219	0.003
Externalizing disorder	166	3.50	0.11	406	3.21	0.07	5.124	0.024	0.009
Substance use disorder	167	4.23	0.09	407	4.28	0.06	0.221	0.639	< 0.001
Crime/violence problems	167	2.33	0.12	405	1.56	0.07	30.212	< .001	0.051

EMM = Estimated marginal means. FDR-corrected p value = 0.0240.

Table 4
Logistic regression of GAIN-Short Screener extension items based on initiation of cannabis use at under 14 years of age versus at age 14 or over, controlling for sex and duration of use.

GAIN-SS Extension Item	Cannabis initiation < 14		Cannabis initiation 14+		Wald Chi ²	p	OR
	N	%	N	%			
Skipping meals, purging	70	39.3%	222	50.5%	6.314	0.012	0.577 (0.376, 0.886)
Binge eating	80	45.2%	235	53.4%	2.952	0.086	0.689 (0.451, 1.054)
Disturbed by memories/dreams	151	84.8%	342	77.4%	1.310	0.252	1.362 (0.802, 2.314)
Had thoughts that people are watching/following/out to get you	101	57.1%	232	53.0%	1.608	0.205	1.296 (0.868, 1.935)
Saw/heard things no one else could	63	35.6%	124	28.6%	1.446	0.229	1.298 (0.849, 1.985)
Problematic videogame playing/internet use	63	35.4%	190	43.2%	0.303	0.582	0.863 (0.512, 1.457)
Problematic gambling	7	3.9%	16	3.6%	0.635	0.426	0.655 (0.232, 1.854)

Note. FDR-corrected p value = 0.0193.

Table 5
Multiple regression of demographic, substance use and mental health profiles predicting age of first use of cannabis.

	Model 1			<i>p</i>	Model 2			<i>p</i>
	B	SE B	β		B	SE B	β	
Duration of use	−0.397	0.030	−0.534	< 0.001	−0.367	0.031	−0.493	< 0.001
Sex	−0.057	0.160	−0.014	0.722	−0.148	0.160	−0.037	0.356
Legal system involvement					−0.539	0.166	−0.136	0.001
Precarious housing					0.314	0.301	0.041	0.298
NEET					−0.222	0.164	−0.053	0.176
GAIN-SS externalizing					−0.032	0.067	−0.020	0.636
GAIN-SS crime/violence					−0.260	0.061	−0.188	< 0.001
THS - trauma					0.005	0.028	0.008	8.856
R ² change		0.285				0.068		
F for change in R ²		87.67**				7.63**		

violence ($p < .001$) were significantly higher among youth who began using cannabis prior to the age of 14. Only one of the GAIN-SS extension items was differentially endorsed across the two groups (Table 4): early initiators were significantly less likely to report eating disorder-related weight control behavior ($p = .012$). Youth who began using cannabis before the age of 14 were significantly more likely to be experiencing difficulties across all four areas of concern on the GAIN-SS, i.e., internalizing, externalizing, substance use, and crime/violence concerns (Wald $\chi^2(1) = 11.488$, $p = .001$), controlling for age and duration of use, at 33.7% for the under 14 group and 21.7% for the 14 or over group.

Trauma was further explored given the association between trauma, mental health, and substance use. Younger cannabis initiators reported significantly more types of past trauma (under 14 group: $M = 6.67$; $SD = 3.23$; 14+ group: $M = 4.84$, $SD = 3.08$, $F(1) = 11.427$, $p = .001$), a difference that was significant even when excluding the added bullying items ($F(1) = 15.814$, $p < .001$).

Lastly, multiple regression analysis was conducted to identify the variables independently associated with age of cannabis onset, defined as a continuous variable (Table 5). Results show that the model predicted 34.1% of the variance, with the exposure variables added after the control variables accounting for 6.8% of the variance of age of cannabis use onset in a multivariate model; exposure variables that statistically significantly predicted of earlier age of cannabis use onset were duration of use ($B = -.493$, $p < .001$), legal system involvement ($B = -.136$, $p = .001$), and crime/violence ($B = -.188$, $p < .001$).

4. Discussion

This study characterized clinical risk profiles for those initiating cannabis use in early adolescence (< 14), i.e., prior to the transition to secondary school and in an age range rarely considered in research, in comparison to those initiating cannabis use in mid-to-late adolescence through to early adulthood (14–24), through direct comparison of patterns of substance use behaviours and co-occurring concerns. Nearly 30% of service-seeking youth reported initiating cannabis use before the age of 14. Results support distinct and clinically meaningful differences between these age groups, with earlier cannabis use initiation serving as an important marker for more problematic concurrent mental health and substance use concerns. The under 14 and 14+ groups had similar sociodemographic profiles, with some important differences: the under 14 group was more likely to be NEET, precariously housed, and involved in the legal system. The under 14 group also reported more frequent (near daily) polysubstance use, with an earlier age of onset for all substances.

Youth initiating cannabis use at under age 14 endorsed more externalizing disorder symptoms, more crime/violence-related behaviors, and more co-occurring concerns. Previous work has found that early cannabis onset is associated with anxiety and depression (internalizing disorders) (Hayatbakhsh et al., 2007). This finding did not hold up in the current study; however, internalizing disorder symptoms were high across both early and later onset cannabis users in the current study, suggesting a ceiling effect. The association between early cannabis use and externalizing disorders found in the current study has been previously demonstrated (Behrendt et al., 2012). Co-occurring challenges were highly endorsed: those in the under 14 group in the current sample were more likely to endorse symptoms from all four domains of the GAIN-SS (internalizing, externalizing, problematic substance use, and crime/violence concerns). Higher trauma exposure is an additional notable finding, given the demonstrated association between trauma, mental health challenges, and self-medication via substance use (Garland, Pettus-Davis, & Howard, 2013; Orsolini et al., 2019). Further research is required to better understand the role of a diversity of risk factors — including mental health, concurrent disorders, trauma, environmental and social risk factors — and how they may influence each other leading to varying levels of risk for early age of cannabis use onset.

In terms of polysubstance use profiles, participants who began using cannabis under the age of 14 were more likely to begin their substance use trajectories with cannabis rather than alcohol, which differed from the profiles of those who initiated cannabis at a later age; early cannabis initiators also initiated other substances at a younger age. Behrendt et al. (2012) found that alcohol use preceded cannabis use for a vast majority of young people and that only 4.4% reported initiating cannabis and alcohol use in the same year; given changes in the social acceptability of cannabis, the increased rate of cannabis as a first substance of use and of concurrent onset of cannabis and alcohol may be a cohort effect that requires further attention in research.

Previous literature has supported an association between early cannabis initiation and the development of CUD (Behrendt et al., 2009). However, little guiding research is available to shed light on the trajectories of the earliest cannabis initiators. Previous research has pointed to the role of polysubstance use in ongoing substance use trajectories (e.g., Behrendt, et al., 2012; Pampati, Buu, Hu, Mendes de Leon, and Lin (2018)), a finding that was supported in the current study. There are a number of possible risk and protective factors that may potentially mediate and moderate progression to CUDs, such as resilience, substance use among peers, polysubstance use, legal system involvement, and mental health service. An important future research direction will be to investigate the role of diverse risk factors and protective factors in the progression towards and away from CUD.

A secondary and more exploratory goal of the current study was to identify which of the sociodemographic, substance use and mental health variables would hold as unique associations with earlier onset cannabis use. Legal system involvement and crime/violence behaviors were most strongly associated with early cannabis initiation. The relation between early cannabis use onset and factors such as crime/violence and externalizing disorders have previously been demonstrated (King, Iacono, & McGue, 2004; Scholes-Balog, Hemphill, Evans-Whipp, Toumbourou, & Patton, 2016)(Savage, King, Clark, & Cropsey, 2017). Youth with legal system involvement are often found to have social networks that consist of peers with behavioral issues and substance use (Sabo, 2017, p. 4364; Simons, Correia, Carey, & Borsari, 1998), and are often characterized as having risk associated with particular personality profiles (e.g. impulsive, sensation seeking, etc.) (Newcomb & McGee, 1991; Zhou et al., 2014). Legal system involvement may reflect social and/or personality risk factors that may be more predictive of early initiation of cannabis. Combined with the higher externalizing disorder symptoms, criminal justice involvement may point to behavioral concerns that may lead to both early cannabis use and crime and violence challenges, although the directionality is unclear. However, it should be noted that most of the data was collected while cannabis use was illegal in Canada for people of all ages locally; further work should explore how these findings might change with changes in legislation. Nevertheless, previous research has suggested that youth with cannabis use who are referred by the criminal justice system may stay in treatment longer than those who were not referred (Kaminer, Ohannessian, & Burke, 2019), and that they can benefit substantially from substance use treatment (Webb, Burleson, & Ungemack, 2002). Additional supports for navigating the criminal justice system may be warranted for some youth in this group.

These findings have important implications for cannabis-use prevention, early intervention, and treatment initiatives. Findings are mixed on whether prevention initiatives are effective in younger or older adolescents. A meta-analysis of cannabis prevention interventions for adolescents (12–19 years of age) found interventions are more effective among high school students (age 14+) than among younger students, a finding that was attributed to developmental factors (Porath-Waller, Beasley, & Beirness, 2010). However, another systematic review found programs designed to prevent cannabis use among adolescents and young adults (11–21 years of age) to be more effective when targeted towards a younger age group (10–13 years of age), since the program would potentially precede the onset of cannabis use (Norberg, Kezelman, & Lim-Howe, 2013). Based on the findings of the current study, interventions aiming to prevent or delay the first use of cannabis should start early, particularly for more vulnerable children and youth. Targeting older students may be too late for some youth. Optimal prevention and early intervention efforts should be developed with the knowledge that some youth will have already tried cannabis, even during childhood; as these may be the most vulnerable youth, it should be kept in mind that they may also have considerably more concurrent issues. Preventionists and early interventionists are encouraged to continue working to optimize cannabis prevention programs in age-appropriate ways for children and youth at different ages and with different levels of cannabis experience or non-experience.

Overall, these findings have meaningful clinical implications for treatment among youth seeking services across sectors. Notably, the results highlight the importance of taking early cannabis initiation into account to understand the vulnerabilities and concurrent mental health, behavioral, substance use, and other concerns of youth. However, as about half of youth among both early cannabis initiators and later initiators began using cannabis, alcohol, and tobacco at about the same time, the use of any of these substances should be taken into account as markers that may suggest the need for further assessment of substance use. Given the comorbidity of mental health and substance use problems in youth, especially youth with higher levels of vulnerability, like those who initiate cannabis use early, youth-focused service providers are encouraged to consider youth substance use as part of routine youth mental health and wellness services. For youth presenting with substance-related problems, service providers should consider current and previous substance use, particularly age of cannabis use onset, as part of the assessment and service planning process. For treatment services, asking the age of onset of cannabis use may provide insight into historical and current vulnerabilities, as the duration of use is strongly associated with multiple outcomes.

Since cannabis initiation can begin early, it is essential to have early interventions in place to prevent adverse outcomes in later adolescence and adulthood for those youth who do initiate early (Walker, 2017). Effective early interventions include multi-dimensional family therapy, motivational enhancement therapy, and cognitive behavior therapy (Dennis et al., 2004). However, despite the potentially detrimental effects of cannabis use during early adolescence, very few young people receive treatment (Substance Abuse and Mental Health Services Administration, 2017). Barriers to treatment include a lack of treatment seeking due to embarrassment or due to a lack of felt need to discuss these issues or motivation to work on them (Bowers, Cleverley, Di Clemente, & Henderson, 2017; Diamond, Leckrone, Dennis, & Godley, 2006, pp. 247–274; Han, Hedden, Lipari, Copello, & Kroutil, 2015). Youth might be more inclined to seek treatment when substance use is interfering with their mental health, educational attainment, or family, peer and romantic relationships (Bowers et al., 2017). Since parental encouragement and support can be a key factor in youth treatment seeking (Bowers et al., 2017), awareness and promotion interventions should target parents. In addition, adolescents may be open to discussing cannabis use with health care practitioners (Ackard & Neumark-Sztainer, 2001; Substance Abuse and Mental Health Services Administration, 2017), but many may choose not to discuss it without probing; thus the onus of early identification among adolescents may therefore fall on service providers, making systematic screening important.

Several limitations should be kept in mind when interpreting the findings. Notably, the data were self-reported, with retrospective

estimates of the age of onset, which may have affected their validity. In addition, the youth in this current sample only reported past year symptom endorsement on the GAIN-SS. It is unknown whether these symptoms existed at age of initiation or whether symptoms progressed or improved from age of initiation. In the absence of a time course analyses (longitudinal data), the directionality or bi-directionality of these associations is unclear, i.e., it remains to be determined whether early cannabis use represents a unique risk factor for developing problematic mental health and substance use behavior or whether is a marker of shared (e.g., environment) or common underlying risk etiology (e.g., genetics).

These findings support the conclusion that early cannabis initiation is clinically meaningful marker of risk across mental and behavioral health. The initiation of cannabis use at an earlier age than typically considered is associated with particular risk for more complex, concurrent mental and behavioral health concerns. Cannabis use and other substance use, as well as broader mental health challenges should be systematically assessed from an early age, while prevention initiatives designed for younger youth are also called for. Service providers and researchers are encouraged to consider the potential complex comorbidities and polysubstance use patterns of youth who initiate cannabis use early, as well as ways to address factors such as trauma and their role in the early initiation.

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References

- Ackard, D. M., & Neumark-Sztainer, D. (2001). Health care information sources for adolescents: Age and gender differences on use, concerns, and needs. *Journal of Adolescent Health, 29*, 170–176. [https://doi.org/10.1016/s1054-139x\(01\)00253-1](https://doi.org/10.1016/s1054-139x(01)00253-1).
- Arseneault, L., Cannon, M., Poulton, R., Murray, R., Caspi, A., & Moffitt, T. E. (2002). Cannabis use in adolescence and risk for adult psychosis: Longitudinal prospective study. *BMJ, 325*, 1212–1213. <https://doi.org/10.1136/bmj.325.7374.1212>.
- Behrendt, S., Beesdo-Baum, K., Höfler, M., Perkonig, A., Bühringer, G., Lieb, R., et al. (2012). The relevance of age at first alcohol and nicotine use for initiation of cannabis use and progression to cannabis use disorders. *Drug and Alcohol Dependence, 123*, 48–56. <https://doi.org/10.1016/j.drugalcdep.2011.10.013>.
- Behrendt, S., Wittchen, H.-U., Höfler, M., Lieb, R., & Beesdo, K. (2009). Transitions from first substance use to substance use disorders in adolescence: Is early onset associated with a rapid escalation? *Drug and Alcohol Dependence, 99*, 68–78. <https://doi.org/10.1016/j.drugalcdep.2008.06.014>.
- Blanco, C., Rafful, C., Wall, M. M., Ridenour, T. A., Wang, S., & Kendler, K. S. (2014). Towards a comprehensive developmental model of cannabis use disorders. *Addiction, 109*, 284–294. <https://doi.org/10.1111/add.12382>.
- Boak, A., Hamilton, H. A., Adlaf, E. M., & Mann, R. E. (2015). Drug use among Ontario students: Detailed OSDUHS findings, 1977–2015. *CAMH research document series No. 41* (pp. 342). Toronto, Canada: Centre for Addiction and Mental Health.
- Boak, A., Hamilton, H. A., Adlaf, E. M., & Mann, R. E. (2017). Drug use among Ontario students, 1977–2017: Detailed findings from the Ontario student drug use and health survey (OSDUHS). *CAMH research document series No. 46*. Toronto, ON: Centre for Addiction and Mental Health.
- Bolger, K. E., & Patterson, C. J. (2001). Pathways from child maltreatment to internalizing problems: Perceptions of control as mediators and moderators. *Development and Psychopathology, 13*, 913–940. <https://doi.org/10.1017/S0954579401004096>.
- Bowers, A., Cleverley, K., Di Clemente, C., & Henderson, J. (2017). Transitional-aged youth perceptions of influential factors for substance-use change and treatment seeking. *Patient Preference and Adherence, 11*, 1939–1948. <https://doi.org/10.2147/PPA.S145781>.
- Brownlie, E., Beitshman, J. H., Chaim, G., Wolfe, D. A., Rush, B., & Henderson, J. (2018). Early adolescent substance use and mental health problems and service utilisation in a school-based sample. *Canadian Journal of Psychiatry, 64*, 116–125. <https://doi.org/10.1177/0706743718784935>.
- Calakos, K. C., Bhatt, S., Foster, D. W., & Cosgrove, K. P. (2017). Mechanisms underlying sex differences in cannabis use. *Current Addiction Reports, 4*, 439–453. <https://doi.org/10.1007/s40429-017-0174-7>.
- Carliner, H., Keyes, K. M., McLaughlin, K. A., Meyers, J. L., Dunn, E. C., & Martins, S. S. (2016). Childhood trauma and illicit drug use in adolescence: A population-based national comorbidity survey replication-adolescent supplement study. *Journal of the American Academy of Child & Adolescent Psychiatry, 55*, 701–708. <https://doi.org/10.1016/j.jaac.2016.05.010>.
- Carlson, E. B., Smith, S. R., Palmieri, P. A., Dalenberg, C., Ruzek, J. I., Kimerling, R., et al. (2011). Development and validation of a brief self-report measure of trauma exposure: The Trauma History Screen. *Psychological Assessment, 23*, 463. <https://doi.org/10.1037/a0022294>.
- Casadio, P., Fernandes, C., Murray, R. M., & Di Forti, M. (2011). Cannabis use in young people: The risk for schizophrenia. *Neuroscience & Biobehavioral Reviews, 35*, 1779–1787. <https://doi.org/10.1016/j.neubiorev.2011.04.007>.
- Castellanos-Ryan, N., Pingault, J.-B., Parent, S., Vitaro, F., Tremblay, R. E., & Seguin, J. R. (2017). Adolescent cannabis use, change in neurocognitive function, and high-school graduation: A longitudinal study from early adolescence to young adulthood. *Development and Psychopathology, 29*, 1253–1266. <https://doi.org/10.1017/S0954579416001280>.
- Chen, C.-Y., Storr, C. L., & Anthony, J. C. (2009). Early-onset drug use and risk for drug dependence problems. *Addictive Behaviors, 34*, 319–322. <https://doi.org/10.1016/j.addbeh.2008.10.021>.
- Chestnut Health Systems (2010). *GAIN-SS 2.0.3 - CAMH version*. Bloomington, IL: Chestnut Health Systems.
- Copeland, J., Rooke, S., & Swift, W. (2013). Changes in cannabis use among young people: Impact on mental health. *Current Opinion in Psychiatry, 26*, 325–329. <https://doi.org/10.1097/YCO.0b013e328361eae5>.
- Degenhardt, L., Chiu, W., Conway, K., Dierker, L., Glantz, M., Kalaydjian, A., et al. (2009). Does the 'gateway' matter? Associations between the order of drug use initiation and the development of drug dependence in the national comorbidity study replication. *Psychological Medicine, 39*, 157–167. <https://doi.org/10.1017/S0033291708003425>.
- Dennis, M. L., Chan, Y. F., & Funk, R. R. (2006). Development and validation of the GAIN Short Screener (GSS) for internalizing, externalizing and substance use disorders and crime/violence problems among adolescents and adults. *American Journal on Addictions, 15*(Suppl 1), 80–91. <https://doi.org/10.1080/10550490601006055>.
- Dennis, M. L., Godley, S. H., Diamond, G., Tims, F. M., Babor, T., Donaldson, J., et al. (2004). The cannabis youth treatment (CYT) study: Main findings from two randomized trials. *Journal of Substance Abuse Treatment, 27*, 197–213. <https://doi.org/10.1016/j.jsat.2003.09.005>.
- Dennis, M. L., White, M., Titus, J., & Unsicker, J. (2008). In C. H. Systems (Ed.). *Global appraisal of individual needs: Administration guide for the GAIN and related measures (version 5)*.
- Diamond, G., Leckrone, J., Dennis, M., & Godley, S. H. (2006). *The cannabis youth treatment study: The treatment models and preliminary findings*. Cambridge: Cambridge University Press Vol. International Research Monographs in the Addictions.
- Ellickson, P. L., Martino, S. C., & Collins, R. L. (2004). Marijuana use from adolescence to young adulthood: Multiple developmental trajectories and their associated outcomes. *Health Psychology, 23*, 299. <https://doi.org/10.1037/0278-6133.23.3.299>.
- Farmer, R. F., Seeley, J. R., Kosty, D. B., Gau, J. M., Duncan, S. C., Lynskey, M. T., et al. (2015). Internalizing and externalizing psychopathology as predictors of cannabis use disorder onset during adolescence and early adulthood. *Psychology of Addictive Behaviors, 29*, 541. <https://doi.org/10.1037/adb0000059>.
- Fergusson, D. M., & Horwood, L. J. (2000). Does cannabis use encourage other forms of illicit drug use? *Addiction, 95*, 505–520. <https://doi.org/10.1046/j.1360-0443>.

- 2000.9545053.x.
- Fontes, M. A., Bolla, K. I., Cunha, P. J., Almeida, P. P., Jungerman, F., Laranjeira, R. R., et al. (2011). Cannabis use before age 15 and subsequent executive functioning. *British Journal of Psychiatry*, *198*, 442–447. <https://doi.org/10.1192/bjp.bp.110.077479>.
- Garland, E. L., Pettus-Davis, C., & Howard, M. O. (2013). Self-medication among traumatized youth: Structural equation modeling of pathways between trauma history, substance misuse, and psychological distress. *Journal of Behavioral Medicine*, *36*, 175–185. <https://doi.org/10.1007/s10865-012-9413-5>.
- Grant, C. N., & Bélanger, R. E. (2017). Cannabis and Canada's children and youth. *Paediatrics and Child Health*, *22*, 98–102. <https://doi.org/10.1093/pch/pxx017>.
- Grevenstein, D., & Kröninger-Jungaberle, H. (2015). Two patterns of cannabis use among adolescents: Results of a 10-year prospective study using a growth mixture model. *Substance Abuse*, *36*, 85–89. <https://doi.org/10.1080/08897077.2013.879978>.
- Han, B., Hedden, S. L., Lipari, R., Copello, E. A., & Kroutil, L. A. (2015). Receipt of services for behavioral health problems: Results from the 2014 national survey on drug use and health. In M. D. Rockville (Ed.). *Substance abuse and mental health services administration (SAMHSA)*.
- Hayatbakhsh, M. R., Najman, J. M., Jamrozik, K., Mamun, A. A., Alati, R., & Bor, W. (2007). Cannabis and anxiety and depression in young adults: A large prospective study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*, 408–417. <https://doi.org/10.1097/chi.0b013e31802dc54d>.
- IBM Corp (2016). *IBM SPSS statistics for windows*. Armonk, NY: IBM CorpVersion 24.0.
- Kaminer, Y., Ohannessian, C., & Burke, R. (2019). Retention and treatment outcome of youth with cannabis use disorder referred by the legal system. *Adolesc Psychiatry (Hilversum)*, *9*, 4–10. <https://doi.org/10.2174/2210676608666181102145040>.
- King, S. M., Iacono, W. G., & McGue, M. (2004). Childhood externalizing and internalizing psychopathology in the prediction of early substance use. *Addiction*, *99*, 1548–1559. <https://doi.org/10.1111/j.1360-0443.2004.00893.x>.
- Lubman, D. I., Yücel, M., & Hall, W. D. (2007). Substance use and the adolescent brain: A toxic combination? *Journal of Psychopharmacology*, *21*, 792–794. <https://doi.org/10.1177/0269881107078309>.
- Lynskey, M., & Hall, W. (2000). The effects of adolescent cannabis use on educational attainment: A review. *Addiction*, *95*, 1621–1630. <https://doi.org/10.1046/j.1360-0443.2000.951116213.x>.
- Micallef, L., & Rodgers, P. (2014). eulerAPE: Drawing area-proportional 3-Venn diagrams using ellipses. *PLoS One*, *9*, Article e101717. <https://doi.org/10.1371/journal.pone.0101717>.
- Mills, R., Kisely, S., Alati, R., Strathearn, L., & Najman, J. M. (2017). Child maltreatment and cannabis use in young adulthood: A birth cohort study. *Addiction*, *112*, 494–501. <https://doi.org/10.1111/add.13634>.
- Moberg, D. P. (2003). *Screening for alcohol and other drug problems using the adolescent alcohol and drug involvement scale (AADIS)*. Madison, WI: Center for Health Policy and Program Evaluation, University of Wisconsin-Madison.
- Moore, T. H., Zammit, S., Lingford-Hughes, A., Barnes, T. R., Jones, P. B., Burke, M., et al. (2007). Cannabis use and risk of psychotic or affective mental health outcomes: A systematic review. *The Lancet*, *370*, 319–328. [https://doi.org/10.1016/S0140-6736\(07\)61162-3](https://doi.org/10.1016/S0140-6736(07)61162-3).
- Narum, S. R. (2006). Beyond Bonferroni: Less conservative analyses for conservation genetics. *Conserv Genet*, *7*, 783–787. <https://doi.org/10.1007/s10592-005-9056-y>.
- Newcomb, M. D., & McGee, L. (1991). Influence of sensation seeking on general deviance and specific problem behaviors from adolescence to young adulthood. *Journal of Personality and Social Psychology*, *61*, 614. <https://doi.org/10.1037/0022-3514.61.4.614>.
- Norberg, M. M., Kezelman, S., & Lim-Howe, N. (2013). Primary prevention of cannabis use: A systematic review of randomized controlled trials. *PLoS One*, *8*, Article e53187. <https://doi.org/10.1371/journal.pone.0053187>.
- Orsolini, L., Chiappini, S., Volpe, U., Berardis, D., Latini, R., Papanti, G. D., et al. (2019). Use of medicinal cannabis and synthetic cannabinoids in post-traumatic stress disorder (PTSD): A systematic review. *Medicina (Kaunas)*, *55*. <https://doi.org/10.3390/medicina55090525>.
- Pampati, S., Buu, A., Hu, Y.-H., Mendes de Leon, C. F., & Lin, H.-C. (2018). Effects of alcohol and cigarette use on the initiation, reinitiation, and persistence of cannabis use from adolescence to emerging adulthood. *Addictive Behaviors*, *79*, 144–150. <https://doi.org/10.1016/j.addbeh.2017.12.019>.
- Paus, T. (2005). Mapping brain maturation and cognitive development during adolescence. *Trends in Cognitive Sciences*, *9*, 60–68. <https://doi.org/10.1016/j.tics.2004.12.008>.
- Porath-Waller, A. J., Beasley, E., & Beirness, D. J. (2010). A meta-analytic review of school-based prevention for cannabis use. *Health Education & Behavior*, *37*, 709–723. <https://doi.org/10.1177/1090198110361315>.
- Rioux, C., Castellanos-Ryan, N., Parent, S., Vitaro, F., Tremblay, R. E., & Séguin, J. R. (2018). Age of cannabis use onset and adult drug abuse symptoms: A prospective study of common risk factors and indirect effects. *Canadian Journal of Psychiatry*, *63*, 457–464. <https://doi.org/10.1177/0706743718760289>.
- Sabo, V. (2017). *Social relationships in young offenders: Relevance to peers, poverty, and psychological adjustment* Electronic Thesis and Dissertation Repository.
- Savage, R. J., King, V. L., Clark, C. B., & Cropsey, K. L. (2017). Factors associated with early marijuana initiation in a criminal justice population. *Addictive Behaviors*, *64*, 82–88. <https://doi.org/10.1016/j.addbeh.2016.08.005>.
- Scholes-Balog, K. E., Hemphill, S. A., Evans-Whipp, T. J., Toumbourou, J. W., & Patton, G. C. (2016). Developmental trajectories of adolescent cannabis use and their relationship to young adult social and behavioural adjustment: A longitudinal study of Australian youth. *Addictive Behaviors*, *53*, 11–18. <https://doi.org/10.1016/j.addbeh.2015.09.008>.
- Semple, D. M., McIntosh, A. M., & Lawrie, S. M. (2005). Cannabis as a risk factor for psychosis: Systematic review. *Journal of Psychopharmacology*, *19*, 187–194. <https://doi.org/10.1177/0269881105049040>.
- Shedler, J., & Block, J. (1990). Adolescent drug use and psychological health: A longitudinal inquiry. *American Psychologist*, *45*, 612. <https://doi.org/10.1037/0003-066x.45.5.612>.
- Silins, E., Horwood, L. J., Patton, G. C., Fergusson, D. M., Olsson, C. A., Hutchinson, D. M., et al. (2014). Young adult sequelae of adolescent cannabis use: An integrative analysis. *The Lancet Psychiatry*, *1*, 286–293. [https://doi.org/10.1016/s2215-0366\(14\)70307-4](https://doi.org/10.1016/s2215-0366(14)70307-4).
- Simons, J., Correia, C. J., Carey, K. B., & Borsari, B. E. (1998). Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. *Journal of Counseling Psychology*, *45*, 265–273. <https://doi.org/10.1037/0022-0167.45.3.265>.
- Smith, T., Hawke, L., Chaim, G., & Henderson, J. (2017). Housing instability and concurrent substance use and mental health concerns: An examination of Canadian youth. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *26*, 214–223.
- Social Exclusion Unit (1999). In HMSO (Ed.). *Bridging the gap: New opportunities for 16-18 year olds not in education, employment or training* (London, UK).
- Substance Abuse and Mental Health Services Administration (2017). *Key substance use and mental health indicators in the United States: Results from the 2016 national survey on drug use and health (HHS publication No. SMA 17-5044, NSDUH Series H-52)*. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration.
- Sung, M., Erkanli, A., Angold, A., & Costello, E. J. (2004). Effects of age at first substance use and psychiatric comorbidity on the development of substance use disorders. *Drug and Alcohol Dependence*, *75*, 287–299. <https://doi.org/10.1016/j.drugalcdep.2004.03.013>.
- Tu, A. W., Ratner, P. A., & Johnson, J. L. (2008). Gender differences in the correlates of adolescents' cannabis use. *Substance Use & Misuse*, *43*, 1438–1463. <https://doi.org/10.1080/10826080802238140>.
- Walker, D. D. (2017). Legalization of cannabis: Considerations for intervening with adolescent consumers. *Preventive Medicine*, *104*, 37–39. <https://doi.org/10.1016/j.ypmed.2017.07.010>.
- Webb, C. P. M., Burleson, J. A., & Ungemack, J. A. (2002). Treating juvenile offenders for marijuana problems. *Addiction*, *97*, 35–45. <https://doi.org/10.1046/j.1360-0443.97.s01.9.x>.
- Wilkinson, S. T., Radhakrishnan, R., & D'Souza, D. C. (2014). Impact of cannabis use on the development of psychotic disorders. *Current Addiction Reports*, *1*, 115–128. <https://doi.org/10.1007/s40429-014-0018-7>.
- Winters, K. C., & Lee, C. Y. (2008). Likelihood of developing an alcohol and cannabis use disorder during youth: Association with recent use and age. *Drug and Alcohol Dependence*, *92*, 239–247. <https://doi.org/10.1016/j.drugalcdep.2007.08.005>.
- World Health Organization (2016). Growing up unequal: Gender and socioeconomic differences in young people's health and well-being: 2007 health behaviour in school-aged children (HBSC) study: International report from the 2013/2014 survey. *Health policy for children and adolescents: No. 7* (Copenhagen, Denmark).
- Zhou, J., Witt, K., Chen, C., Zhang, S., Zhang, Y., Qiu, C., et al. (2014). High impulsivity as a risk factor for the development of internalizing disorders in detained juvenile offenders. *Comprehensive Psychiatry*, *55*, 1157–1164. <https://doi.org/10.1016/j.comppsy.2014.03.022>.