Marijuana Trajectories in Canadian Youth: Associations With Substance Use and Mental Health

Kara Thompson
St. Francis Xavier University

Gabriel J. Merrin, Megan E. Ames,
and Bonnie Leadbeater
University of Victoria

We differentiated marijuana-use trajectories in a large cohort of Canadian youth and compared the use of other substances, mental health symptoms, and behavioural problems for each of the identified trajectories at their baselines in adolescence (ages 12 to 18) and their endpoints (ages 22 to 29). Data came from the Victoria Healthy Youth Survey, a 10-year prospective study of a random community sample of 662 participants in Victoria, British Columbia, Canada (48% male; $M_{age} = 15.5$). Canadian youth were followed biennially for six assessments from 2003 to 2013. Five distinct marijuana-use classes were identified using latent-class growth-curve analyses: abstainers (29%), occasional users (27%), decreasers (14%), increasers (20%), and chronic users (11%). Lower use classes typically began use after age 15. Chronic users had more problem behaviours (e.g., attention-deficit/hyperactivity disorder, oppositional–defiant disorder, and conduct problems) in both adolescence and young adulthood and more depressive symptoms in young adulthood than other classes. Decreasers reported more depressive symptoms in adolescence than chronic users and were less likely to co-use other substances in young adulthood. Increasers were similar to chronic users in young adulthood, but reported more illicit drug use and lower levels of depressive and oppositional–defiant disorder symptoms. Problematic marijuana use occurs in the context of mental health and problem behaviours as well as other substance-use concerns. Prevention and treatment approaches need to include anticipation and treatment of co-occurring problems to stem negative effects of marijuana during the transition from adolescence to young adulthood.

Public Significance Statement
Early-onset and persistent high-frequency marijuana use is associated with negative outcomes for youth. Results show that patterns of marijuana use are firmly situated in contexts of polysubstance use and co-occurring mental health and behavioural problems during both adolescence and young adulthood. Acknowledging, assessing, and treating these co-occurring problems will be necessary to stem negative effects of marijuana-use patterns on developmental outcomes for youth.

Keywords: marijuana use, mental health, trajectories, latent-class growth analysis, youth

Canadian adolescents are among the youngest and most frequent users of marijuana in the developed world. According to a United Nations Children's Fund survey (UNICEF, 2013), 28% of 11–15-year-old Canadians reported marijuana use in the past year. The Canadian Tobacco, Alcohol and Drugs Survey (Statistics Canada, 2015) estimated that 22% of 15–19-year-olds and 26% of 20–24-year-olds used marijuana during the past 12 months. These are the highest rates of use of all age groups examined. Frequency, quantities, and trajectories of use across the years from adolescence to young adulthood have not yet been investigated in Canadian samples. However, studies from the United States typically identify five or six distinctive trajectories of marijuana use, all of which have led to the identification of a small group of youth who start to use marijuana early (typically before age 15) and become chronic and frequent users. Overall, these youth experience more negative educational, economic, and relationship outcomes in adulthood than nonusers (Brook, Lee, Brown, Finch, & Brook, 2011; Brook, Zhang, & Brook, 2011; Ellickson, Martino, & Collins, 2004; Epstein et al., 2015; Nelson, van Ryzin, & Dishion, 2015; Pahl, Brook, & Koppel, 2011). Few studies have contrasted chronic use with alternate patterns of use (e.g., adolescent-limited or occasional use), and little is known about how youth substance use, mental health, and behavioural concerns relate to different trajectories of use during adolescence and young adulthood.

Substance use, mental health, and behavioural concerns frequently co-occur in adolescence and young adulthood. Indeed, in both

community-based and clinical samples of adolescents, rates of co-occurrence between a variety of internalizing and externalizing symptoms approximate 50% to 60% (e.g., Costello, Copeland, & Angold, 2011). Hence, risks for negative outcomes that are attributed to marijuana-use trajectories alone may be overlooking pre- or coexisting mental health or behavioural problems and co-use of other substances.

In this study, using latent-class growth-curve analyses (LCGAs), we differentiated marijuana-use trajectories in a large cohort of youth, aged 12 to 18 in 2003, who were followed for 10 years. We compared the use of other substances (i.e., cigarettes, alcohol, and illicit drugs), mental health symptoms (i.e., depression and anxiety), and behavioural problems (i.e., attention-deficit/hyperactivity disorder [ADHD], oppositional–defiant disorder [ODD], and conduct problems) across each of the identified trajectories at both their onset in adolescence (at ages 12 to 18) and endpoints (at ages 22 to 29). We expected that the different trajectories of marijuana use would also show differences in mental health symptoms, behavioural problems, and co-use of other substances in both adolescence and young adulthood. Moreover, whereas past research has typically focused on the contrasting characteristics of chronic or frequent user groups with nonusers, we also paid particular attention to illuminating the substance co-use, mental health symptoms, and behavioural problems across each of the marijuana-use trajectories. Realistic portrayals of the variability of use patterns and their correlates are needed to target prevention efforts for youth most at risk of marijuana-related harms.

Trajectories of Marijuana Use From Adolescence to Adulthood

A growing body of research includes documented variability in marijuana-use trajectories using person-centered methods (e.g., LCGAs), primarily with samples from the United States (e.g., Brook, Lee et al., 2011; Brook, Zhang, Leukefeld, & Brook, 2016; Caldeira, O'Grady, Vincent, & Arria, 2012; Epstein et al., 2015; Nelson et al., 2015; Pahl, Brook, & Koppel, 2011; Schulenberg et al., 2005; Terry-McElrath et al., 2017; Windle & Wiesner, 2004). The number of identified classes ranges from three to seven, reflecting the sample specificity of these analytical methods and methodological differences (e.g., ages and ethnicities studied and operationalization of marijuana use). All studies identified a *chronic*-use group who begin using marijuana in adolescence and continue use into young adulthood (i.e., ranging from a few times/month to a few times/week or more). Other trajectories include an *increasing*-use group of youth who begin use in mid-to-late adolescence and increase to high levels of use in young adulthood (i.e., ranging from several times per month to several times per week), sometimes exceeding levels of chronic users (Brook, Lee et al., 2011, 2016; Ellickson et al., 2004; Nelson et al., 2015; Pahl et al., 2011; Passarotti, Crane, Hedeker, & Mermelstein, 2015); an *adolescent-limited* group who peak in early adulthood (i.e., at less than weekly use) and then decline to little or no use by the late 20's (Brook, Lee et al., 2016; Epstein et al., 2015; Nelson et al., 2015); an *occasional-* or *light*-use group with stable low levels of use over time (Brook, Lee et al., 2011, 2016; Ellickson et al., 2004; Nelson et al., 2015), and an *early decliners* or *quitters* group who report at least monthly marijuana use in early to mid-adolescence, but decline to little or no use in young adulthood (Brook, Lee et al., 2011; Brook et al., 2016; Pahl et al., 2011; Nelson et al., 2015). Research on the trajectories of marijuana use with Canadian youth is needed to assess whether use

patterns and risks identified in the United States characterise Canadian youth. Moreover, understanding the correlates of use trajectories in Canadian youth may also add significantly to the literature as acceptance continues to rise with the national legalization of recreational uses anticipated in 2018.

Substance Co-Use, Mental Health Symptoms, and Behavioural Problems Associated With Marijuana-Use Trajectories

Trajectories characterised by high levels of marijuana use, such as chronic or increasing classes, also report higher levels of alcohol or illicit drug use and a greater likelihood of having a substance-use disorder in adulthood than trajectories characterised by nonuse (Ellickson et al., 2004; Homel, Thompson, & Leadbeater, 2014; Nelson et al., 2015; Pahl et al., 2011). Only Epstein et al. (2015) showed that substance-use levels were also higher at onset and endpoints of the trajectories for chronic and adolescent-limited users.

Associations between internalizing symptoms and marijuana trajectories are inconsistent, with some studies finding no association (Brook, Lee et al., 2011; Passarotti et al., 2015; Windle & Wiesner, 2004) and others showing that chronic users have poorer mental health than nonusers (Brook, Lee et al., 2011; Epstein et al., 2015; Pahl et al., 2011). Variability in findings across studies may partially reflect a failure to distinguish depressive and anxious symptoms, the cyclical nature of these symptoms, or a lack of control over externalizing, which is frequently comorbid with internalizing problems (Costello et al., 2011).

Chronic-use trajectories are also associated with behavioural problems, including criminal behaviour (Brook, Lee et al., 2011; Epstein et al., 2015), antisocial behaviour and delinquency (Brook, Zhang et al., 2011; Brook et al., 2016; Passarotti et al., 2015), and aggression (Pahl et al., 2011) in adolescence and young adulthood. To date, no researchers have examined the association between marijuana-use trajectories and specific behavioural disorders such as ADHD, ODD, and conduct problems. Symptoms of ODD can persist into young adulthood (Leadbeater & Homel, 2015) and present risks for educational and occupational outcomes (Leadbeater & Ames, 2017).

The Current Study

Knowledge about the variability of trajectories of marijuana use in Canadian youth, as well as their predictors and consequences, is lacking. In the current study, we estimated trajectories of young marijuana users over a decade, i.e., from ages 15 to 28. Identification of heterogeneous trajectories of marijuana use can help distinguish between problematic and nonproblematic use patterns, identify subgroups of young people who are at increased risk for experiencing negative consequences from their use, and inform prevention efforts (Schulenberg et al., 2005). We expected that trajectories characterised by early onset and chronic or increasing use would show the highest levels of co-use of other substances, co-occurring mental health symptoms, and behavioural problems in both adolescence and young adulthood. We also expected that trajectories characterised by decreasing use or later onset would show fewer mental health symptoms and behavioural problems at the onset of those trajectories. A more nuanced understanding of how mental health and behavioural problems and co-use of other

substances differentiate patterns of marijuana use from adolescence to young adulthood could better inform the development and implementation of targeted education, as well as prevention and intervention approaches.

Method

Participants and Procedure

The Victoria Healthy Youth Survey (V-HYS) was a 10-year prospective longitudinal study of youth followed biennially for six assessments. The sample was representative of the population surveyed (see Leadbeater, Thompson, & Gruppuso, 2012 for further details). In 2003, participants were recruited from a random sample of 9,500 telephone listings; 1,036 households with eligible children (ages 12 to 18 years) were identified. Of these, 662 agreed to participate in the study. Youth and the parent or guardian for youth under age 18 gave written consent for participation at each wave, and youth received a gift certificate at each interview. A trained interviewer administered the V-HYS individually in each adolescent's home or another private place. To enhance privacy, the portion of the V-HYS questionnaire dealing with private topics (e.g., marijuana use, problem behaviours) was self-administered (i.e., the interviewer did not read the questions aloud) and participants placed this portion of the questionnaire in a sealed envelope and gave it to the interviewer. The university's research ethics board approved the research protocol.

Retention rates were higher and comparable to longitudinal studies with community samples in the United States (e.g., Schulenberg et al., 2005; Terry-McElrath et al., 2017), with 87% retained at Time (T) 2, 81% at T3, 69% at T4, 70% at T5, and 72% at T6. Attrition was assessed by testing for differences in T1 study variables between youth who remained in the study ($n = 478$) and those who did not participate at Time 6 ($n = 184$). The participants who dropped out were more likely to be males, $\chi^2(1, 662) = 8.77$, $p = .003$ and were from lower socioeconomic status (SES) families, $F(1, 636) = 19.39$, $p < .001$. Those lost at follow-up were slightly more likely to be smokers, $F(1, 660) = 3.82$, $p = .05$ and had higher baseline levels of ADHD, $F(1, 660) = 5.63$, $p = .02$. No other group differences were significant.

Measures

Marijuana use. To assess the frequency of marijuana use, participants were asked "How often marijuana (pot, hash) was used in the past 12 months." Responses were given on a 5-point scale: $0 = never$, $1 = a few times a year$, $2 = a few times a month$, $3 = once a week$, and $4 = more than once a week$. The amount used in one day was reported in response to the question: "During the last 3 months, on a day when you used marijuana, cannabis or hashish roughly how many joints did you usually have in that day? (Count 10 puffs, five bong or pipe hits, or 1/2 gram as equivalent to one joint)" (Zeisser et al., 2012).

Cigarettes. Youth indicated how many cigarettes they smoked in the past week. The number of cigarettes used was skewed because of low occurrence, so responses were dichotomized to 0 (*none*) and 1 (*one or more per week*).

Heavy episodic drinking (HED). Participants asked how often they had five or more drinks on one occasion in the past year:

$0 = never$, $1 = a few times a year$, $2 = a few times a month$, $3 = once a week$, and $4 = more than once a week$. The definition of a standard drink was provided (see Evans-Polce, Vasilenko, & Lanza, 2015).

Illicit drug use. Using both formal and street names, participants were asked how often they used each of the following six illicit drugs in the past year: hallucinogens, amphetamines, club drugs, inhalants, cocaine, and heroin as $0 = never$, $1 = a few times a year$, $2 = a few times a month$, $3 = once a week$, and $4 = more than once a week$. Because of the low occurrence of ratings exceeding 1, responses were dichotomized to 0 (*none*) or 1 (*used at least one illicit drug in the past year*).

Marijuana- and alcohol-use disorders. At T6, using the Mini-International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998), responses to 10 items tapping *DSM–5* (*Diagnostic and Statistical Manual of Mental Disorders*, 5th ed.; American Psychiatric Association, 2013) symptoms (i.e., used more than planned, had to increase use to get the same effects, experienced withdrawal symptoms, tried to quit and failed, or used despite experiencing problems) were coded as 0 (*no*) or 1 (*yes*) and summed for marijuana and alcohol use separately. Consistent with *DSM–5* criteria for a substance-use disorder, a score of 2 or more was used to indicate having a substance-use disorder.

Mental health symptoms. The Brief Child and Family Phone Interview (BCFPI; Cunningham, Boyle, Hong, Pettingill, & Bohaychuk, 2009) assesses *DSM–IV*-oriented criteria (*Diagnostic and Statistical Manual of Mental Disorders*, 4th ed., text rev.; APA, 2000) for child and adolescent psychiatric disorders, including depressive symptoms (e.g., Feel hopeless? Have no interest in your usual activities?), anxiety symptoms (e.g., Worry about doing the wrong thing? Are overly anxious to please people?), ODD symptoms (e.g., Argue a lot with others? Are cranky?) and ADHD symptoms (e.g., Jump from one activity to another? Are impulsive?). The BCFPI uses six items for each disorder and has demonstrated strong psychometric properties with the present sample (see Leadbeater et al., 2012). Items for each domain are rated on a 3-point Likert scale ($0 = never$, $1 = sometimes$, and $2 = often$). Totals are used for this study (ranges = $0–12$). Polychoric αs (Gadermann, Guhn, & Zumbo, 2012) were good for each of the domains at T1 and T6, respectively: .87 and .92 for depression, .81 and .88 for anxiety, .74 and .82 for ADHD, and .79 and .85 for ODD.

At T1, conduct problems were assessed using six items from the BCFPI (Cunningham et al., 2009) plus two additional items to reflect *DSM–IV* criteria for conduct disorders (e.g., given a fake excuse for missing work, not showing up for a meeting, or cutting class; damaged public or private property that didn't belong to you; started a fight and struck someone because you didn't like what that person said or did). All items were rated on the same Likert scale as above and were summed (polychoric $\alpha = .90$). At T6, the scale included seven items (range = $0–7$; polychoric $\alpha = .76$). Because of the low occurrence of ratings exceeding 1, responses were collapsed to reflect $0 = never$ and $1 = once or twice$.

SES. Participant-reported parent occupations were coded from 1 to 9 using the Hollingshead Occupational Status Scale (Bornstein, Hahn, Suwalsky, & Haynes, 2003). The highest level of occupational prestige for either parent was used as a measure of SES.

Statistical Analyses

LCGA (Jung & Wickrama, 2008) was used to differentiate marijuana-use trajectories based on the frequency of marijuana use. LCGA classifies responses into heterogeneous subpopulations, each with its own distribution and growth trajectory. To estimate trajectories, time was represented by age in years, that is, we restructured the six waves of data according to participant age. Fifty-three percent of participants ($n = 350$) participated in all six waves of data, 16% ($n = 107$) participated in five waves, 10% ($n = 63$) participated four waves, 8% ($n = 55$) participated in three waves, 6% ($n = 40$) participated in two waves, and 7% ($n = 47$) participated in one wave. The 662 participants provided a total of 3,219 observations to estimate trajectories of marijuana use from ages 12 to 29. However, data observations between ages 12–14 and 29 were not included in the estimate of trajectory classes because of the low frequency of marijuana use at these ages (12, $n = 2$; 13, $n = 7$; 14, $n = 27$; 29, $n = 39$) and resulting low covariance coverage. Thus, trajectories estimate marijuana use from ages 15 to 28. We used the three-step estimation procedure recommended by Asparouhov and Muthén (2014) that includes (a) estimating the latent-class trajectory model, (b) determining the measurement error for the model-class assignment, and (c) fixing the measurement error to accounts for the uncertainty in model-class assignment prior to estimating a model examining predictors and distal outcomes. This model-based approach accounts for the misclassification in modal-class assignments (i.e., measurement error in the most likely class assignment).

Specifically, using frequency of marijuana use specified as an ordered categorical variable, we fit an unconditional latent-growth model to examine the functional form of our data. Consistent with past research (Homel et al., 2014; Schulenberg et al., 2005), a quadratic growth function fit the data best. Several criteria were considered to determine the appropriate number of classes; the log likelihood, the Bayesian information criterion (BIC), the adjusted Vuong–Lo–Mendell–Rubin likelihood-ratio test (VLMR-LRT), the bootstrapped likelihood-ratio test (BLRT), posterior class probabilities, and entropy (Jung & Wickrama, 2008; Nylund, Asparouhov, & Muthén, 2007). The selection of the best model was based on a combination of the following (a) higher log likelihood, (b) lowest BIC, (c) statistically significant likelihood tests, (d) posterior probabilities of correct class assignment (i.e., >.70; Nagin, 2005), as well as (e) theory and parsimony, and (f) size and interpretability of the classes (Jung & Wickrama, 2008; Nylund et al., 2007).

After class-based trajectories were identified, multinomial logistic regression was used to assess baseline (T1) correlates of trajectory-class membership (at ages 12 to 18), and linear regression was used to examine young adulthood (T6) correlates of marijuana-use trajectories (at ages 22 to 29). Substance-use variables and mental health symptoms at T6 were run in separate models. Associations between class membership and adolescent and young adulthood correlates controlled for sex, SES, age at T1, and concurrent levels of all substance use and mental health symptoms. For young adult correlates, baseline levels of substance-use and mental health symptoms were also controlled for. Adjusting for age at T1 accounted for heterogeneity in baseline age and minimized the likelihood that observed trajectory differences reflected variation in age. All analyses were fit using Mplus Version 7.3 using full-information maximum likelihood (FIML), with the robust maximum likelihood estimator

(MLR) adjusting for nonnormality and missing data (Muthén & Muthén, 1998–2012).

Results

LCGA of Marijuana Use

Table 1 presents the fit statistics comparing one-class to six-class solutions. Although the BIC was lower for the six-class solution, the VLMR-LRT was not significant, and the entropy was slightly higher (.72) than the five-class model. Thus, the five-class model was chosen because it fit the data best overall (BIC = 6,472.03; entropy = .71; VLMR-LRT $p = .010$; BLRT $p < .001$) and the classes represented unique trajectories of marijuana use, were consistent with those commonly found in the literature, and were substantively and clinically meaningful. Figure 1 shows the fitted growth curves for each of the five classes of marijuana use from ages 15 to 28 based on most probable class assignment. The five trajectories included abstainers ($n = 183$; 29%), or those who never used marijuana. Occasional users ($n = 172$; 27%) started as abstainers in adolescence, and increased use up to *a few times per year* after age 17. Decreasers ($n = 89$; 14%) used marijuana a *few times per month* at age 15 and decreased to *less than a few times per year* by age 23. The increasers ($n = 127$; 20%) already used *a few times per year* by age 15 and increased rapidly, peaking at more than *once per week* about age 22 and then declining to a *few times per month* by age 28. Chronic users ($n = 69$; 11%) used marijuana *more than once per week* across all ages. The average posterior class-membership probabilities were all above the minimum .70 thresholds for class assignment (range = .73 to .87; Nagin, 2005) and the overall entropy for the five-class model was .71. Means and standard deviations for demographic, substance-use, mental health, and behavioural variables at T1 and T6 are shown for each class in Table 2.

Adolescent Correlates (Precursors) of Marijuana-Use Trajectories

Table 3 summarizes findings for the multinomial logistic regression measuring the associations between the adolescent demographic (ages 12 to 18), substance-use, and mental health variables and the five marijuana trajectories. Pairwise group comparisons were used to assess the significance of trajectory-class differences. Increasers and chronic users were more likely to be male. Chronic users came from

Table 1

Fit Statistics for Nested Latent Class Growth Analyses for Marijuana Use

Number of classes	BIC	VLMR-LRT	BLRT	Entropy
1 class	7,691.14	—	—	—
2 classes	6,809.06	$p < .001$	$p < .001$	.79
3 classes	6,565.74	$p < .001$	$p < .001$	.74
4 classes	6,519.41	$p = .064$	$p < .001$	.72
5 classes	6,472.03	$p = .010$	$p < .001$	.71
6 classes	6,430.73	$p = .185$	$p < .001$	.72

Note. BIC = Bayesian information criterion; VLMR-LRT = Vuong–Lo–Mendell–Rubin-adjusted likelihood ratio test; BLRT = bootstrapped likelihood ratio test. Significant p values indicate better fit than the previous $k - 1$ model as assessed by the VLMR-LRT and BLRT.
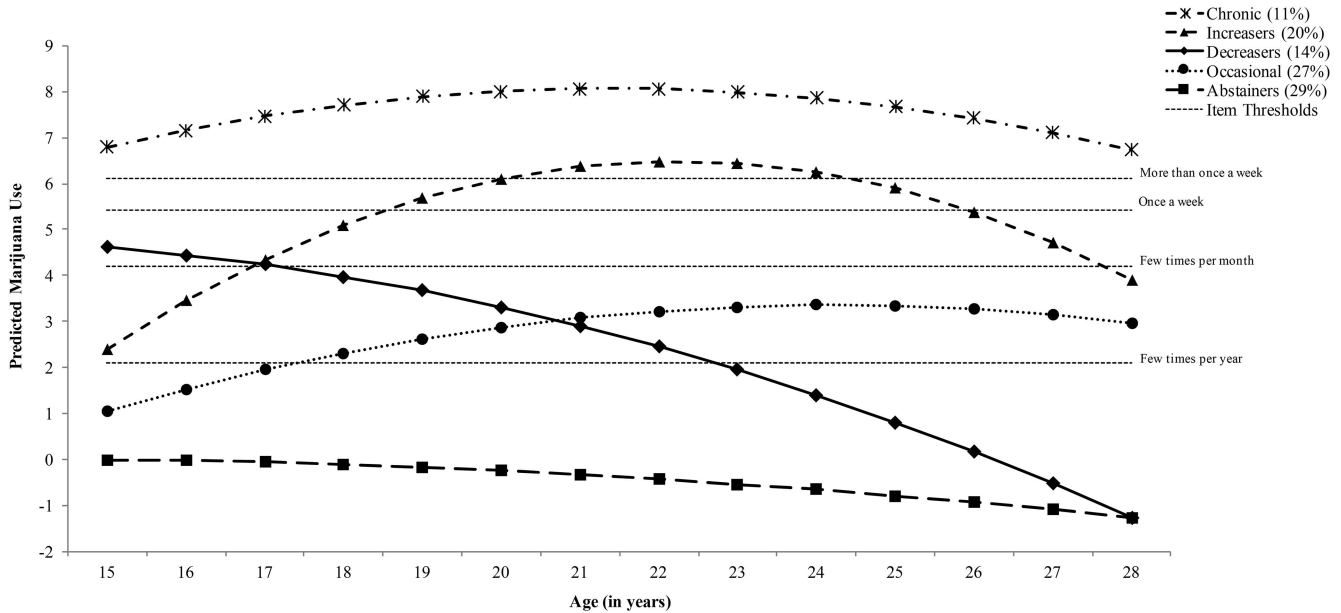
Figure 1. Plotted latent classes of marijuana use from 15 to 28 years of age. *Note:* Log-odds trajectories are on arbitrary scales; as such, the estimated thresholds that divide the categories of observed data are shown as dashed lines to facilitate interpretation.

families with lower SES than youth in other classes, apart from the increasers.

Adolescent substance use. Chronic users were more likely to use cigarettes than abstainers, occasional users, and increasers; a one-unit increase in cigarette use was associated with 13.41 times the odds of being a chronic user compared with abstainers. Youth in each of the trajectory classes were also more likely to report HED than abstainers. Increasers and chronic users also reported higher HED than occasional users. Chronic users and decreasers both reported more illicit drug use than abstainers, occasional users, and increasers. compared with abstainers, a one-unit increase in illicit drug use was associated with 43.18 times the odds of being in the decreasers class and 75.85 times the odds of being a chronic user.

Adolescent mental health symptoms and behavioural problems. Only decreasers were distinctive in terms of mental health symptoms (i.e., depression and anxiety) in adolescence; youth in this class were more likely to report depressive symptoms than chronic users and less likely to report anxiety symptoms than abstainers and occasional users. Increasers also reported fewer anxiety symptoms than occasional users.

Behavioural problems differentiated the marijuana-use trajectory classes from the abstainers and occasional users. Specifically, chronic users were also more likely to report ADHD and ODD symptoms than abstainers, occasional users, and increasers. Further, decreasers, increasers, and chronic users reported significantly more adolescent conduct problems compared with abstainers and occasional users.

Young-Adult Correlates (Outcomes) of Marijuana-Use Trajectories

Results summarising marijuana-class differences for substance use and mental health symptoms and behavioural problems in adulthood

(T6) are shown in Table 4. For continuous variables, we show adjusted means that account for all baseline and within-time (T6) covariates included in the model. For dichotomous outcomes, findings are presented as a probability (*Pr*) of the event occurring, calculated from the threshold provided in the output, $Pr(1) = 1/(1 + \exp(\text{threshold})$, based on L. K. Muthén and Muthén (1998–2012). Pairwise group comparisons were used to assess the significance of trajectory-class differences. Wald tests were used to test overall model significance and pairwise group differences ($p < .05$). Separate models were computed with (a) the substance-use variables combined, and (b) the mental health and behavioural problems combined.

Young-adult substance use. The overall omnibus test of group differences was significant for all forms of substance use except for marijuana-use disorders (see Table 4). Pairwise class comparisons among classes are also shown in Table 4. Increasers showed higher rates of cigarette use than the other classes, except chronic users. Occasional users and increasers showed higher rates of HED in young adulthood compared with abstainers. Increasers also showed higher rates of illicit drug use than all other classes.

For substance-use disorders, occasional users and increasers reported significantly higher odds of having an alcohol use disorder compared with abstainers but did not differ significantly from chronic users. There were no differences in marijuana-use disorders across classes; however, the estimates for abstainers and decreasers could not be estimated, as none (0%) of the participants in these classes met criteria for a marijuana-use disorder (see Table 2).

Young-adult mental health symptoms and behavioural problems. The overall omnibus test of group differences was significant for all mental health and behavioural problems (see Table 4). Findings adjusted for baseline levels of mental health and behavioural symptoms and concurrent correlations between the variables (depression, anxiety, ADHD, ODD, and conduct problems). Chronic users were more

Table 2

Descriptive Mean (or n) and Standard Deviation (or %) Comparisons Across Trajectories

Variables	1. Abstainers (n = 183; 29%)		2. Occasional (n = 172; 27%)		3. Decreasers (n = 89; 14%)		4. Increasers (n = 127; 20%)		5. Chronic (n = 69; 11%)	
	Mean (n)	SD (%)	Mean (n)	SD (%)	Mean (n)	SD (%)	Mean (n)	SD (%)	Mean (n)	SD (%)
Time 1 (ages 12 to 18)										
Sex										
Male	74	40%	72	42%	42	47%	78	61%	41	59%
Female	109	60%	100	58%	47	53%	49	39%	28	41%
SES	6.66	1.69	6.75	1.63	6.64	1.76	6.56	1.82	6.00	1.85
Age	15.09	1.91	14.97	1.89	15.12	2.06	15.28	1.79	15.10	1.87
Age at marijuana onset	17.07	2.68	16.56	2.53	14.37	1.76	15.11	1.65	13.28	1.98
Marijuana use (*average*)	.09	.36	.35	.65	1.18	1.21	.98	1.22	2.48	1.74
Never	170	93%	123	72%	33	37%	62	49%	19	28%
A few times per year	9	5%	42	24%	25	28%	28	22%	3	4%
A few times per month	4	2%	5	3%	20	23%	23	18%	7	10%
Once a week	0	0%	0	0%	4	5%	5	4%	6	9%
More than once a week	0	0%	2	1%	7	8%	9	7%	34	49%
Substance use										
Cigarette use	7	4%	10	6%	14	16%	17	13%	26	38%
Heavy episodic drinking	.16	.53	.46	.84	.80	1.01	.97	1.18	1.39	1.32
Illicit drug use	4	2%	15	9%	20	23%	17	14%	30	44%
Mental health symptoms										
Depressive symptoms	2.36	2.43	2.85	2.65	3.50	2.58	2.55	2.37	3.33	2.52
Anxiety symptoms	5.85	2.64	6.12	2.51	5.48	2.67	5.57	2.52	6.07	2.51
Behavioural problems										
ADHD symptoms	4.14	2.48	4.54	2.31	5.19	2.05	4.45	2.28	6.20	2.65
ODD symptoms	3.83	2.22	4.01	2.26	4.69	2.23	4.16	2.05	5.88	2.38
Conduct problems	.47	.88	.83	1.51	1.38	1.72	1.18	1.46	2.06	1.83
Time 6 (ages 22 to 29)										
Marijuana use (*average*)	.04	.23	.55	.73	.17	.40	1.27	1.12	2.60	2.33
Never	130	95%	28	21%	49	78%	6	6%	1	2%
A few times per year	7	5%	70	53%	13	21%	23	25%	3	7%
A few times per month	0	0%	21	16%	1	2%	16	17%	3	7%
Once a week	0	0%	5	4%	0	0%	13	14%	6	13%
More than once a week	0	0%	9	7%	0	0%	36	38%	32	71%
Substance use										
Cigarette use	11	8%	24	18%	13	20%	35	38%	23	52%
Heavy episodic drinking	.80	.96	1.46	1.12	1.45	1.15	1.99	1.16	2.09	1.41
Illicit drug use	7	5%	42	31%	18	28%	56	60%	23	50%
Alcohol-use disorder	24	18%	63	47%	25	38%	48	52%	29	67%
Marijuana-use disorder	0	0%	17	13%	0	0%	30	32%	26	59%
Mental health symptoms										
Depressive symptoms	2.51	2.67	3.08	2.47	2.55	2.32	2.63	2.64	4.47	3.00
Anxiety symptoms	5.36	2.93	5.88	2.64	4.82	2.67	4.95	2.55	6.29	3.00
Behavioural problems										
ADHD symptoms	3.34	2.37	3.99	2.37	3.29	2.26	3.98	2.24	4.96	2.63
ODD symptoms	2.63	2.05	3.13	1.97	2.94	2.30	3.05	2.11	4.78	2.52
Conduct problems	.73	.92	1.11	.98	.88	1.09	1.29	1.21	1.56	1.01

Note. SES = socioeconomic status; ADHD = attention-deficit/hyperactivity disorder; ODD = oppositional-defiant disorder. Classes are based on modal class assignments. Percentages refer to column totals within each respective category.

Table 3

Estimates, Standard Errors, and Odds Ratios of Demographic, Substance-Use, and Mental Health Correlates Across Marijuana-Use Classes Compared With Abstainers in Adolescence (T1; Ages 12 to 18)

Variables	2. Occasional (n = 172; 27%)		3. Decreasers (n = 89; 14%)		4. Increasers (n = 127; 20%)		5. Chronic (n = 69; 11%)		Pairwise comparisons
	Est. (SE)	OR	Est. (SE)	OR	Est. (SE)	OR	Est. (SE)	OR	p < .05
Demographics									
Sex (ref. = male)	−.02 (.29)	.98	−.18 (.36)	.84	−1.01** (.30)	.37	−.94* (.37)	.39	4, 5 < 1, 2; 4 < 3
SES	.04 (.08)	1.04	.00 (.11)	1.00	−.03 (.09)	.97	−.26** (.10)	.77	5 < 1, 2, 3
Age	−.06 (.08)	.95	.03 (.11)	1.03	.09 (.07)	1.09	.03 (.09)	1.03	
Substance use									
Cigarette use	−.77 (1.85)	.49	1.73 (1.07)	5.61	1.21 (.87)	3.37	2.60** (.99)	13.41	5 > 1, 2, 4
Heavy episodic drinking	1.61** (.55)	4.99	2.14*** (.60)	8.49	2.28*** (.58)	9.78	2.51*** (.62)	12.27	2, 3, 4, 5 > 1; 4, 5 > 2
Illicit drug use	2.13 (1.47)	8.40	3.77** (1.44)	43.18	2.49 (1.48)	12.07	4.33** (1.45)	75.85	5, 3 > 1, 2, 4
Mental health symptoms and behavioural problems									
Depressive symptoms	.06 (.08)	1.06	.17 (.11)	1.18	.04 (.08)	1.04	−.08 (.11)	.93	3 > 5
Anxiety symptoms	.09 (.07)	1.09	−.26** (.10)	.77	−.10 (.07)	.91	−.07 (.10)	.94	1, 2 > 3; 2 > 4
ADHD symptoms	.04 (.07)	1.04	.07 (.10)	1.07	−.05 (.08)	.95	.30** (.11)	1.35	5 > 1, 2, 4
ODD symptoms	−.13 (.09)	.88	.06 (.12)	1.07	−.01 (.09)	.99	.28* (.13)	1.32	5 > 1, 2, 4
Conduct problems	.25 (.27)	1.29	1.00*** (.25)	2.72	.89*** (.23)	2.43	.98*** (.23)	2.67	3, 4, 5 > 1, 2

Note. SES = socioeconomic status; ADHD = attention-deficit/hyperactivity disorder; ODD = oppositional–defiant disorder. Models for substance-use and mental health symptoms controlled for sex, age at T1, and SES. Sample sizes for each trajectory group were based on class assignment using the posterior probability of group membership.
* $p < .05$. ** $p < .01$. *** $p < .001$.

likely to report symptoms of depression in young adulthood than all the other classes. However, occasional users also reported more symptoms than decreasers. Chronic users also reported higher levels of anxiety symptoms compared with abstainers and decreasers. Occasional users reported more anxiety than increasers. Chronic users reported more ADHD symptoms than decreasers and were more likely to report symptoms of ODD than all the other classes. Occasional users reported more ADHD symptoms than decreasers, were more likely to report ODD

Table 4

Adjusted Means, Standard Errors, and Probabilities of Substance-Use and Mental Health Correlates by Marijuana-Use Trajectories in Young Adulthood (T6; Ages 22 to 29)

Variables	1. Abstainers (n = 183; 29%)	2. Occasional (n = 172; 27%)	3. Decreasers (n = 89; 14%)	4. Increasers (n = 127; 20%)	5. Chronic (n = 69; 11%)	Overall wald	Pairwise comparisons
	Adjusted mean (SE)	Adjusted mean (SE)	Adjusted mean (SE)	Adjusted mean (SE)	Adjusted mean (SE)	χ²	p < .05
Substance use							
Cigarette use (Pr)	.03	.19	.16	.61	.36	37.50***	4 > 1, 2, 3; 5 > 1
Heavy episodic drinking	.82 (.37)	1.52 (.38)	1.03 (.39)	2.72 (1.19)	1.49 (1.03)	66.14***	2, 4 > 1
Illicit drug use (Pr)	—a	.47	.23	.88	.62	18.32***	4 > 2, 3, 5
Substance-use disorders							
Alcohol-use disorder (Pr)	.30	.75	.43	.87	.74	36.41***	2, 4 > 1
Marijuana-use disorder (Pr)a	—a	.19	—a	.33	.85	4.89	
Mental health symptoms and behavioural problems							
Depressive symptoms	2.03 (.57)	2.76 (.61)	1.57 (.64)	1.87 (.67)	4.37 (.82)	13.07**	5 > 1, 2, 3, 4; 2 > 3
Anxiety symptoms	3.16 (.60)	3.78 (.63)	2.74 (.68)	2.82 (.66)	4.50 (.68)	9.41*	2 > 4; 5 > 1, 3
ADHD symptoms	2.47 (.54)	3.09 (.57)	1.92 (.58)	2.86 (.65)	3.52 (.74)	10.83*	2, 5 > 3
ODD symptoms	1.59 (.47)	2.34 (.45)	1.48 (.54)	1.71 (.52)	3.57 (.56)	16.04**	5 > 1, 2, 3, 4; 2 > 1, 3
Conduct problems	.66 (.25)	1.11 (.25)	.73 (.29)	1.13 (.44)	1.72 (.54)	22.19***	2 > 1

Note. Pr = probability of event occurrence for dichotomous outcomes; ADHD = attention deficit/hyperactivity disorder; ODD = oppositional–defiant disorder. Models for substance-use and mental health symptoms controlled for sex, socioeconomic status, age at T1, and respective T1 assessment. Sample sizes for each trajectory group were based on class assignment using the posterior probability of group membership.
a Could not be estimated because of low within-class variability.
* $p < .05$. ** $p < .01$. *** $p < .001$.

symptoms than abstainers and decreasers, and reported more conduct problems than abstainers.

Discussion

Using person-centered analyses, we identified five trajectories of marijuana use assessed over a decade in a community sample of Canadian youth aged 15 to 28, including abstainers (29%), who never used marijuana; occasional users (27%), who started in mid-adolescence and increased use to a *few times a year* after age 17; decreasers (14%), who used a *few times per month* at age 15 and decreased to *less than a few times per year* by age 23; increasers (20%) increased rapidly across adolescence, peaking at *more than once per week* at about age 22 and then declining to *a few times per month* by age 28; and, chronic users ($n = 69$; 11%), who started very early (age 13) and used marijuana *more than once per week* across all ages. The identified patterns were similar to those found in United States samples, although, notably, the proportion of youth classified in a higher use group (i.e., chronic users or increasers), and the frequency of marijuana use in these higher use groups, was greater in our sample than United States-based community samples (Brook, Zhang et al., 2011) and more comparable to a high-risk United States sample (Epstein et al., 2015).

While considerable attention is being paid to identifying differences in marijuana-use trajectories, our findings make it clear that these differences are not independent of other substance use, mental health symptoms, and behavioural concerns. Consistent with previous research, in this study, males were overrepresented in the higher risk trajectories (i.e., increasers and chronic users). The greater occurrence of behavioural problems in these high-risk classes may partially explain these sex differences. However, the sample size was inadequate for the assessment of sex differences in trajectories, predictors, or outcomes. Although there is some overlap in the age range for these trajectory classes, our findings show that youth in the abstainer or occasional user trajectories, on average, start use after age 16, whereas youth in the higher risk trajectories began using marijuana at or before age 15. Chronic users reported very early average age of onset (13 years). Early onset of use is a consistent correlate of high-risk use and efforts to delay onset are warranted. Given that the majority of youth who went on to increasing or chronic marijuana use began before age 17, it appears unlikely that regulations designating the age of majority (age 18) as the legal age for recreational use will impact the early onset of use in high-risk groups.

Adolescent Correlates of Marijuana-Use Trajectories

Predicting who will go on to have high-risk patterns of marijuana use is aided by an understanding of correlates of adolescent risks that are associated with diverse patterns of use over time. In adolescence, youth who went on to become chronic users were distinct from other classes by their early onset of marijuana use, their early co-use of cigarettes and illicit drugs, and behavioural problems (ADHD, ODD, and conduct problems). Chronic users and increasers were also likely to be male and to come from lower SES families. Increasers, who also showed a high-risk pattern of use, were similar to chronic users in their HED and conduct problems in adolescence, but had low levels of other concerns.

The co-occurrence of polysubstance use and behavioural problems suggests reasons that youth in the chronic user group may be caught in trajectories of long-term problematic marijuana use. Studies of polysubstance use have similarly identified classes of youth using high levels of several substances (Connor, Gullo, White, & Kelly, 2014; Conway et al., 2013) who may also have an underlying addiction proneness associated with personality, behavioural, and environmental problems (Moss, Chen, & Yi, 2014). Some research also suggests that these coalescing concerns may relate to genetic and neurological vulnerabilities that are triggered and sustained by environmental risks (Luciana, 2013; Moss et al., 2014). Combinations of ADHD, ODD, and conduct problems may also lure youth into associations with similarly high-risk peers (Epstein et al., 2015). Disruption of cascading substance use and behavioural problems in chronic users may require active screening of adolescents identified through any of several intervention channels (i.e., substance use, mental health, justice, or educational tracts) and efforts to engage these youth in early treatment. Investments in multisystemic therapies have shown benefits in reducing these co-morbid concerns in adolescents (Riedinger, Pinquart, & Teubert, 2017).

Decreasers had similarly high probabilities of reporting illicit drug use and conduct problems as chronic users in adolescence. However, distinguishing this class from the others, they reported higher levels of adolescent depressive symptoms than chronic users, less anxiety than abstainers and occasional users and fewer ADHD and ODD symptoms. Both marijuana use and depressive symptoms showed an interesting co-occurring decline over time for decreasers, with levels similar to abstainers by young adulthood. The early high co-occurrence between depression and marijuana use for this group may be explained by other social and/or contextual factors not examined in the current study, such as family functioning (i.e., divorce, residential moves). Resolution of these issues may contribute to declines in both depression and marijuana use over time for these youth. Further, declines in marijuana use for decreasers may also partially reflect the low levels of co-occurring ADHD (e.g., inattention and hyperactivity) and ODD (e.g., irritability and defiance) symptoms for this group that likely contribute to sustained marijuana use over time for other groups (i.e., chronic users). Further research into the factors contributing to this early, high co-occurrence, as well as factors supporting declines (e.g., quality of relationships with families, educational opportunities, moves away from high school peer networks), could inform targeted or secondary prevention efforts or treatments.

Abstainers (29%) and occasional users (27%) were similar in substance use, mental health symptoms, and behavioural problems at the beginning of their trajectories, except that occasional users reported higher levels of HED. HED was common across all marijuana-use classes and is considered a rite of passage by many adolescents (Crawford & Novak, 2006). Combined, the abstainers and occasional user classes comprised most of the youth in the current sample (55%), showing that most youth typically start with small amounts of infrequent use after age 16 and make responsible decisions about their marijuana use across young adulthood.

Young Adult Correlates of Marijuana-Use Trajectories

Problematic co-use of other substances and alcohol-use disorders were evident in both increasers and chronic users (compared with abstainers). In fact, illicit drug use was highest among the increasers, even compared with chronic users. Increasers also had similarly high levels of cigarette use and HED to chronic users in

young adulthood, but increasers appear to taper off in their frequency of marijuana use by age 28 (e.g., shifting from a *few times a week* at age 24 to *once a week* or *a few times a month* by age 27–28); members of this group are characterised by their very high patterns of polysubstance use, which is not developmentally normative for this age. Most young adults peak in their substance use much earlier (Evans-Polce et al., 2015; Thompson, Stockwell, Leadbeater, & Homel, 2014) and show declines in use with the adoption of adult roles (e.g., full-time employment, relationships, children; Bachman et al., 2002). The high levels of polysubstance use among increasers and chronic users are likely to create challenges for several important life outcomes during this critical developmental period, including educational attainment, employment, and relationship satisfaction (Green et al., 2016). In contrast to chronic users, increasers showed fewer comorbid mental health concerns, such as depression and ODD symptoms; however, continued high levels of polysubstance use among these youth may to contribute to the development of mental health problems in the future (Salom, Betts, Williams, Najman, & Alati, 2016). Addressing polysubstance use and symptoms of alcohol- and marijuana-use disorders include acknowledging symptoms of dependency (e.g., needing more drug to create the same effect) and the negative effects of use on their work and close relationships. Working with these insights to motivate changes in use behaviours could support treatment efforts for these higher risk groups.

Behavioural problems, including ADHD and ODD symptoms, continued to distinguish chronic users from the other groups in young adulthood. As argued above, these stable behavioural symptoms may reflect neurologically based and environmentally sustained vulnerabilities (Connor et al., 2014; Luciana 2013). By young adulthood, chronic users also reported more depressive symptoms than the other trajectory classes and more anxiety symptoms than all classes except occasional users. Depressive symptoms in chronic users may be a consequence of problems with education, work, and relationships that have been found in high-risk groups in past research (Brook et al., 2016; Epstein et al., 2015). Marijuana use is correlated with higher levels of depressive symptoms (Lev-Ran et al., 2014; Pacek, Martins, & Crum, 2013) and risks may be greater for those who co-use alcohol (Pacek et al., 2013). Some research has also suggested that the development of depressive symptoms and anxiety is associated with high levels of marijuana use in adolescence and that the effect on depression may be more likely for those who were younger at onset (Copeland, Rooke, & Swift, 2013) and for women (Degenhardt et al., 2013; Patton et al., 2002).

Surprisingly, as young adults, occasional users had higher probabilities of mental health symptoms and behavioural problems than all other classes except chronic users. Brook et al. (2016) similarly found that occasional users (i.e., users who started late and used marijuana less than on a monthly basis, but stayed at that level into their 40s) had a higher likelihood of engaging in unconventional behaviours, greater emotional dysregulation, and higher levels of substance dependence and sensation seeking than abstainers or experimental users. Notably, occasional users do not appear to mature out of their casual use of marijuana as we might expect. Thus, while occasional use itself may not present risk, a pattern of persistent but low levels of marijuana use over time may have negative effects on young-adult outcomes by enhancing symptoms of depression and anxiety, ADHD, and ODD and by exposing youth in this class to others who use marijuana or illicit substances.

It is also notable that females were overrepresented in this category and that the quadratic shape of this trajectory was similar to the increasers, who were more likely to be male, used less frequently, and started later. Women may experience higher risks in adulthood at lower levels of use, given the association between marijuana use and unconventional behaviours and the greater vulnerably of women to depression in adolescence and young adulthood (Dekker et al., 2007). The notable sex differences in use patterns warrant further study and research on the functional outcomes in adulthood for occasional users is needed.

Limitations

Although participants came from diverse socioeconomic backgrounds, the patterns identified in the sample may not be characteristic of all Canadian youth and young adults, particularly youth from large multiethnic cities. Our sample was predominately Caucasian and drawn from a single midsize Canadian city in British Columbia. Prevalence rates for cannabis use near the time data were collected suggest small provincial differences in past-year prevalence, ranging from 10% (Saskatchewan) to 16% (Nova Scotia; Health Canada, 2012). British Columbia, on average, tends to have higher use (14% in 2012) and tolerance for marijuana. Thus, patterns may not reflect use in jurisdictions where it is less accepted and where use is actively policed and prohibited. Further, with the anticipated legalization of recreational marijuana use in 2018, we can expect to see increasing acceptance, availability, and prevalence of cannabis use that may shift the observed use patterns (Salas-Wright, Vaughn, Todic, Córdova, & Perron, 2015), increasing the amounts used and the portion of youth who fall into particular trajectories (i.e., Occasional users).

Further limitations include the fact that all data were obtained via self-report, thus estimates of substance use and mental health symptoms may be underestimated (Akinci, Tarter, & Kirisci, 2001). Moreover, the implications of the marijuana-use trajectories for adolescent and young-adult functioning (e.g., work, postsecondary, education, and relationships quality) were beyond the focus of this study, but these clearly warrant further research. In one of the only studies that reported differences related to young-adult functioning, Epstein et al. (2015) found that chronic users had more negative educational, economic, and relationship outcomes at age 33.

Implications

Our findings indicate that conceptualising marijuana use as a stand-alone problem with an average trajectory that rises in adolescence and falls as adult responsibilities are encountered is clearly limited. We identified several patterns of marijuana use across adolescence and young adulthood. These were partially distinguished by sex and age of onset; chronic users who start using, on average, at age 13 were more likely to be male and report more symptoms of dependence as adults. It is also worth noting that marijuana use is firmly situated in the contexts of binge drinking (HED) and, also, for early-onset users, illicit drug use. The highest risk patterns of use are also related to mental health symptoms and behavioural problems in adolescence; these concerns persist and, for some, worsen by adulthood. Rather than focusing on marijuana use alone, prevention and treatment ap-

proaches need to acknowledge, assess and treat co-occurring mental health and behavioural problems to stem negative effects of them across the salient developmental transition from adolescence to young adulthood.

Résumé

Nous avons différencié les trajectoires en matière d'utilisation de cannabis d'une grande cohorte de jeunes Canadiens et comparé l'utilisation d'autres substances, de symptômes de santé mentale et de problèmes de comportement pour chacune des trajectoires identifiées à leurs lignes de base à l'âge de l'adolescence (entre 12 et 18 ans) et leurs résultats finaux (entre 22 et 29 ans). Les données proviennent de l'Enquête sur les jeunes en santé de Victoria, une étude prospective de 10 ans sur un échantillon de 662 participants sélectionnés au hasard de la collectivité de Victoria, Colombie-Britannique, Canada (48 % d'hommes; âge médian 15,5). Les jeunes Canadiens ont été suivis tous les deux ans au moyen de six évaluations s'échelonnant entre 2003 et 2013. Cinq catégories d'utilisation de cannabis distinctes ont été identifiées à partir d'une analyse de classe latente pour courbe de croissance : abstinents (29 %), utilisateurs occasionnels (27 %), utilisateurs dont la consommation est en baisse (14 %), utilisateurs dont la consommation est en hausse (20 %) et utilisateurs chroniques (11 %). Les catégories d'utilisation moindre ont généralement commencé l'utilisation après l'âge de 15 ans. Les utilisateurs chroniques présentaient davantage de problèmes de comportements (par ex., un trouble de déficit d'attention/hyperactivité, un trouble oppositionnel avec provocation ou un trouble comportemental) tant chez les adolescents que chez les jeunes adultes et davantage de symptômes de dépression chez les jeunes adultes que chez les autres catégories d'âge. Les utilisateurs dont la consommation est en baisse ont signalé plus de symptômes de dépression à l'adolescence que les utilisateurs chroniques et étaient moins susceptibles de co-utiliser d'autres substances au début de l'âge adulte. Les utilisateurs dont la consommation est en hausse ont signalé les mêmes symptômes que les utilisateurs chroniques au début de l'âge adulte, mais ont signalé une utilisation accrue de drogues illicites et des niveaux inférieurs de symptômes de dépression et de troubles oppositionnels avec provocation. L'utilisation problématique de cannabis se produit dans un contexte de santé mentale et de problèmes de comportement ainsi que d'autres préoccupations liées à la consommation de substances. Les approches de prévention et de traitement doivent inclure l'anticipation et la gestion de problèmes survenant en même temps pour contrecarrer les effets négatifs du cannabis lors du passage de l'adolescence au début de l'âge adulte.

Mots-clés : utilisation de cannabis, santé mentale, trajectoires, analyse de classe latente pour courbe de croissance, jeunesse.

References

Akinci, I. H., Tarter, R. E., & Kirisci, L. (2001). Concordance between verbal report and urine screen of recent marijuana use in adolescents. *Addictive Behaviors, 26,* 613–619. http://dx.doi.org/10.1016/S0306-4603(00)00146-5

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

American Psychiatric Association, DSM-5 Task Force. (2013). *DSM 5: Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Press.

Asparouhov, T., & Muthén, B. (2014). Auxiliary variables in mixture modeling: Three-step approaches using Mplus. *Structural Equation Modeling, 21,* 329–341. http://dx.doi.org/10.1080/10705511.2014.915181

Bachman, J. G., O'Malley, P. M., Schulenberg, J. E., Johnston, L. D., Bryant, A. L., & Merline, A. C. (2002). *The decline of substance use in young adulthood: Changes in social activities, roles, and beliefs.* Mahwah, New Jersey: Erlbaum.

Bornstein, M. H., Hahn, C. S., Suwalsky, J. T. D., & Haynes, O. M. (2003). Socioeconomic status, parenting, and child development: The Hollingshead four-factor index of social status and the socioeconomic index of occupations. In M. H. Bornstein & R. H. Bradley (Eds.), *Socioeconomic status, parenting, and child development* (pp. 29–82). Mahwah, NJ: Erlbaum.

Brook, J. S., Lee, J. Y., Brown, E. N., Finch, S. J., & Brook, D. W. (2011). Developmental trajectories of marijuana use from adolescence to adulthood: Personality and social role outcomes. *Psychological Reports, 108,* 339–357. http://dx.doi.org/10.2466/10.18.PR0.108.2.339-357

Brook, J. S., Zhang, C., & Brook, D. W. (2011b). Antisocial behavior at age 37: Developmental trajectories of marijuana use extending from adolescence to adulthood. *The American Journal on Addictions, 20,* 509–515. http://dx.doi.org/10.1111/j.1521-0391.2011.00179.x

Brook, J. S., Zhang, C., Leukefeld, C. G., & Brook, D. W. (2016). Marijuana use from adolescence to adulthood: Developmental trajectories and their outcomes. *Social Psychiatry and Psychiatric Epidemiology, 51,* 1405–1415. http://dx.doi.org/10.1007/s00127-016-1229-0

Caldeira, K. M., O'Grady, K. E., Vincent, K. B., & Arria, A. M. (2012). Marijuana-use trajectories during the post-college transition: Health outcomes in young adulthood. *Drug and Alcohol Dependence, 125,* 267–275. http://dx.doi.org/10.1016/j.drugalcdep.2012.02.022

Connor, J. P., Gullo, M. J., White, A., & Kelly, A. B. (2014). Polysubstance use: Diagnostic challenges, patterns of use and health. *Current Opinion in Psychiatry, 27,* 269–275. http://dx.doi.org/10.1097/YCO.0000000000000069

Conway, K. P., Vullo, G. C., Nichter, B., Wang, J., Compton, W. M., Iannotti, R. J., & Simons-Morton, B. (2013). Prevalence and patterns of polysubstance use in a nationally representative sample of 10th graders in the United States. *Journal of Adolescent Health, 52,* 716–723. http://dx.doi.org/10.1016/j.jadohealth.2012.12.006

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. http://dx.doi.org/10.1097/YCO.0b013e328361eae5

Costello, E. J., Copeland, W., & Angold, A. (2011). Trends in psychopathology across the adolescent years: What changes when children become adolescents, and when adolescents become adults? *Journal of Child Psychology and Psychiatry, 52,* 1015–1025. http://dx.doi.org/10.1111/j.1469-7610.2011.02446.x

Crawford, L. A., & Novak, K. B. (2006). Alcohol abuse as a rite of passage: The effect of beliefs about alcohol and the college experience on undergraduates' drinking behaviors. *Journal of Drug Education, 36,* 193–212. http://dx.doi.org/10.2190/F0X7-H765-6221-G742

Cunningham, C. E., Boyle, M. H., Hong, S., Pettingill, P., & Bohaychuk, D. (2009). The Brief Child and Family Phone Interview (BCFPI): 1. Rationale, development, and description of a computerized children's mental health intake and outcome assessment tool. *Journal of Child Psychology and Psychiatry, 50,* 416–423. http://dx.doi.org/10.1111/j.14697610.2008.01970.x

Degenhardt, L., Coffey, C., Romaniuk, H., Swift, W., Carlin, J. B., Hall, W. D., & Patton, G. C. (2013). The persistence of the association between adolescent cannabis use and common mental disorders into young adulthood. *Addiction, 108,* 124–133. http://dx.doi.org/10.1111/j.1360-0443.2012.04015.x

Dekker, M. C., Ferdinand, R. F., van Lang, N. D., Bongers, I. L., van der Ende, J., & Verhulst, F. C. (2007). Developmental trajectories of depressive symptoms from early childhood to late adolescence: Gender

differences and adult outcome. *Journal of Child Psychology and Psychiatry, 48,* 657–666. http://dx.doi.org/10.1111/j.1469-7610.2007.01742.x

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,* 299–307. http://dx.doi.org/10.1037/0278-6133.23.3.299

Epstein, M., Hill, K. G., Nevell, A. M., Guttmannova, K., Bailey, J. A., Abbott, R. D., . . . Hawkins, J. D. (2015). Trajectories of marijuana use from adolescence into adulthood: Environmental and individual correlates. *Developmental Psychology, 51,* 1650–1663. http://dx.doi.org/10.1037/dev0000054

Evans-Polce, R. J., Vasilenko, S. A., & Lanza, S. T. (2015). Changes in gender and racial/ethnic disparities in rates of cigarette use, regular heavy episodic drinking, and marijuana use: Ages 14 to 32. *Addictive Behaviors, 41,* 218–222. http://dx.doi.org/10.1016/j.addbeh.2014.10.029

Gadermann, A. M., Guhn, M., & Zumbo, B. (2012). Estimating ordinal reliability for Likert-type and ordinal item response data: A conceptual, empirical, and practical guide. *Practical Assessment, Research & Evaluation, 17,* 1–13.

Green, K. M., Musci, R. J., Johnson, R. M., Matson, P. A., Reboussin, B. A., & Ialongo, N. S. (2016). Outcomes associated with adolescent marijuana and alcohol use among urban young adults: A prospective study. *Addictive Behaviors, 53,* 155–160. http://dx.doi.org/10.1016/j.addbeh.2015.10.014

Health Canada. (2012). *Canadian Alcohol and Drug Use Monitoring Survey: 2012. Results*. Available at https://www.canada.ca/en/health-canada/services/health-concerns/drug-prevention-treatment/drug-alcohol-use-statistics/canadian-alcohol-drug-use-monitoring-survey-summary-results-tables-2012.html#t1

Homel, J., Thompson, K., & Leadbeater, B. (2014). Trajectories of marijuana use in youth ages 15–25: Implications for postsecondary education experiences. *Journal of Studies on Alcohol and Drugs, 75,* 674–683. http://dx.doi.org/10.15288/jsad.2014.75.674

Jung, T., & Wickrama, K. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass, 2,* 302–317. http://dx.doi.org/10.1111/j.1751-9004.2007.00054.x

Leadbeater, B. J., & Ames, M. E. (2017). The longitudinal effects of oppositional–defiant disorder symptoms on academic and occupational functioning in the transition to young adulthood. *Journal of Abnormal Child Psychology, 45,* 749–763. http://dx.doi.org/10.1007/s10802-016-0190-4

Leadbeater, B. J., & Homel, J. (2015). Irritable and defiant sub-dimensions of ODD: Their stability and prediction of internalizing symptoms and conduct problems from adolescence to young adulthood. *Journal of Abnormal Child Psychology, 43,* 407–421. http://dx.doi.org/10.1007/s10802-014-9908-3

Leadbeater, B., Thompson, K., & Gruppuso, V. (2012). Co-occurring trajectories of symptoms of anxiety, depression, and oppositional defiance from adolescence to young adulthood. *Journal of Clinical Child and Adolescent Psychology, 41,* 719–730. http://dx.doi.org/10.1080/15374416.2012.694608

Lev-Ran, S., Roerecke, M., Le Foll, B., George, T. P., McKenzie, K., & Rehm, J. (2014). The association between cannabis use and depression: A systematic review and meta-analysis of longitudinal studies. *Psychological Medicine, 44,* 797–810. http://dx.doi.org/10.1017/S0033291713001438

Luciana, M. (2013). Adolescent brain development in normality and psychopathology. *Development and Psychopathology, 25,* 1325–1345. http://dx.doi.org/10.1017/S0954579413000643

Moss, H. B., Chen, C. M., & Yi, H. Y. (2014). Early adolescent patterns of alcohol, cigarettes, and marijuana polysubstance use and young adult substance use outcomes in a nationally representative sample. *Drug and Alcohol Dependence, 136,* 51–62. http://dx.doi.org/10.1016/j.drugalcdep.2013.12.011

Muthén, L. K., & Muthén, B. O. (1998–2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Author.

Nagin, D. (2005). *Group-based modeling of development*. Cambridge, MA: Harvard University Press. http://dx.doi.org/10.4159/9780674041318

Nelson, S. E., Van Ryzin, M. J., & Dishion, T. J. (2015). Alcohol, marijuana, and tobacco use trajectories from age 12 to 24 years: Demographic correlates and young adult substance use problems. *Development and Psychopathology, 27,* 253–277. http://dx.doi.org/10.1017/S0954579414000650

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling, 14,* 535–569. http://dx.doi.org/10.1080/10705510701575396

Pacek, L. R., Martins, S. S., & Crum, R. M. (2013). The bidirectional relationships between alcohol, cannabis, co-occurring alcohol and cannabis use disorders with major depressive disorder: Results from a national sample. *Journal of Affective Disorders, 148,* 188–195. http://dx.doi.org/10.1016/j.jad.2012.11.059

Pahl, K., Brook, J. S., & Koppel, J. (2011). Trajectories of marijuana use and psychological adjustment among urban African American and Puerto Rican women. *Psychological Medicine, 41,* 1775–1783. http://dx.doi.org/10.1017/S0033291710002345

Passarotti, A. M., Crane, N. A., Hedeker, D., & Mermelstein, R. J. (2015). Longitudinal trajectories of marijuana use from adolescence to young adulthood. *Addictive Behaviors, 45,* 301–308. http://dx.doi.org/10.1016/j.addbeh.2015.02.008

Patton, G. C., Coffey, C., Carlin, J. B., Degenhardt, L., Lynskey, M., & Hall, W. (2002). Cannabis use and mental health in young people: Cohort study. *British Medical Journal, 325,* 1195–1198. http://dx.doi.org/10.1136/bmj.325.7374.1195

Riedinger, V., Pinquart, M., & Teubert, D. (2017). Effects of systemic therapy on mental health of children and adolescents: A meta-analysis. *Journal of Clinical Child and Adolescent Psychology, 46,* 880–894. https://doi.org/10.1080/15374416.2015.1063427

Salas-Wright, C. P., Vaughn, M. G., Todic, J., Córdova, D., & Perron, B. E. (2015). Trends in the disapproval and use of marijuana among adolescents and young adults in the United States: 2002–2013. *The American Journal of Drug and Alcohol Abuse, 41,* 392–404. http://dx.doi.org/10.3109/00952990.2015.1049493

Salom, C. L., Betts, K. S., Williams, G. M., Najman, J. M., & Alati, R. (2016). Predictors of comorbid polysubstance use and mental health disorders in young adults: A latent class analysis. *Addiction, 111,* 156–164. http://dx.doi.org/10.1111/add.13058

Schulenberg, J. E., Merline, A. C., Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Laetz, V. B. (2005). Trajectories of marijuana use during the transition to adulthood: The big picture based on national panel data. *Journal of Drug Issues, 35,* 255–280. http://dx.doi.org/10.1177/002204260503500203

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for *DSM–IV* and *ICD-10*. *The Journal of Clinical Psychiatry, 59,* 22–33. http://www.psychiatrist.com/jcp/article/Pages/1998/v59s20/v59s2005.aspx

Statistics Canada. (2015). *Canadian Tobacco, Alcohol and Drugs Survey (CTADS)*. Retrieved from http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=4440

Terry-McElrath, Y. M., O'Malley, P. M., Johnston, L. D., Bray, B. C., Patrick, M. E., & Schulenberg, J. E. (2017). Longitudinal patterns of marijuana use across ages 18–50 in a US national sample: A descriptive examination of predictors and health correlates of repeated measures

latent class membership. *Drug and Alcohol Dependence, 171,* 70–83. http://dx.doi.org/10.1016/j.drugalcdep.2016.11.021

Thompson, K., Stockwell, T., Leadbeater, B., & Homel, J. (2014). Association among different measures of alcohol use across adolescence and emerging adulthood. *Addiction, 109,* 894–903. http://dx.doi.org/10.1111/add.12499

United Nations Children's Fund, Office of Research. (2013). *Innocenti Report Card 11: Child well-being in rich countries. A comparative overview*. Florence, Italy: UNICEF Office of Research.

Windle, M., & Wiesner, M. (2004). Trajectories of marijuana use from adolescence to young adulthood: Predictors and outcomes. *Development and Psychopathology, 16,* 1007–1027. http://dx.doi.org/10.1017/S0954579404040118

Zeisser, C., Thompson, K., Stockwell, T., Duff, C., Chow, C., Vallance, K., . . . Lucas, P. (2012). A 'standard joint'? The role of quantity in predicting cannabis-related problems. *Addiction Research & Theory, 20,* 82–92. http://dx.doi.org/10.3109/16066359.2011.569101

E-Mail Notification of Your Latest CPA Issue Online!

Would you like to know when the next issue of your favorite APA journal will be available online? This service is now available to you. Sign up at https://my.apa.org/portal/alerts/ and you will be notified by e-mail when issues of interest to you become available!

Avis par courriel de la disponibilité des revues de la SCP en ligne!

Vous voulez savoir quand sera accessible en ligne le prochain numéro de votre revue de la Société canadienne de psychologie préférée? Il est désormais possible de le faire. Inscrivez-vous à https://my.apa.org/portal/alerts/ et vous serez avisé par courriel de la date de parution en ligne des numéros qui vous intéressent!