



Trends in cannabis use over time among Canadian youth: 2004–2014

Cesar Leos-Toro^a, Vicki Rynard^b, Donna Murnaghan^c, Jo-Ann MacDonald^d, David Hammond^{a,*}

^a School of Public Health & Health Systems, University of Waterloo, 200 University Ave W., Waterloo, ON N2L 3G1, Canada

^b Propel Centre for Population Health Impact, University of Waterloo, 200 University Ave W., Waterloo, ON N2L 3G1, Canada

^c School of Nursing, Thompson Rivers University, 805 TRU Way, Kamloops, BC V2C 0C8, Canada

^d Faculty of Nursing, University of Prince Edward Island, 550 University Avenue, Charlottetown, PEI C1A 4P3, Canada



ARTICLE INFO

Keywords:

Cannabis
Cannabis use trends
Adolescents
Health behaviour in school-aged children
Canadian cannabis use trends

ABSTRACT

Cannabis is the most commonly used illicit substance among Canadian youth. The current study examined national trends in cannabis use among Canadian youth from 2004/05 to 2014/15 using nationally representative data from the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS). Data were collected from students in Grades 7 to 12 as part of the Canadian Student Tobacco, Alcohol and Drugs Survey (formerly the Youth Smoking Survey) using a repeat-cross sectional survey across 6 biennial survey waves between 2004 and 2014 (N = 243,057). Regression models examined factors associated with cannabis use in the past 12 months, perceived ease of access, and a multilinear regression examined age of initiation across survey cycles. The findings indicate that use of cannabis in the past 12-months significantly decreased among Canadian youth. Past-year use peaked in 2008/09 at 27.3%; compared to 16.5%, in 2014/15. Mean age of initiation did not vary over time, while youth in recent cycles reported that cannabis was more difficult to access: in 2006/07, 77.1% reported that it would be easy to access cannabis compared to 49.0% in 2014/15. Overall, cannabis use among Canadian youth appears to have peaked around 2008/09, with substantial declines over the past decade. It will be critically important to examine any changes in patterns of use following legalization of non-medical cannabis in Canada.

1. Introduction

Cannabis is the most commonly used illicit substance in Canada (Government of Canada, 2016a). Canadian youth were recently identified as having among the highest rates of past-year use compared to youth in other industrialized nations (UNICEF Office of Research, 2013; United Nations Office on Drug and Crime, 2016). According to the 2015 Canadian Tobacco, Alcohol and Drugs Survey, one in five youth (20.6%) aged 15 to 19 years reported using cannabis in the past 12 months (Government of Canada, 2016a). The widespread use of cannabis among youth is a public health concern given that early initiation has been associated with a number of negative health and social outcomes, including a greater likelihood of dependence and problematic use, poor school performance, onset of substance use disorders, and adverse mental health outcomes (National Academies of Sciences, Engineering, and Medicine, 2017; Hall et al., 2016). Frequent use of cannabis among youth has also been associated with disadvantages later in the life course such as limited educational attainment, unemployment, and lower life satisfaction (Fergusson and Boden, 2008;

Silins et al., 2014; George and Vaccarino, 2015).

‘Early’ initiation of cannabis is often defined as use prior to adulthood or 18 years of age (Brook et al., 1999; Pope et al., 2003). The average age of cannabis initiation in Canada in 2012 was 14 years among youth attending high school, with similar ages of initiation among girls and boys (Government of Canada, 2016b). The median age across the general Canadian population over 15 years of age was 17 years old for males and females (Government of Canada, 2016a). Delaying the age of initiation among youth – particularly with respect to daily use – is an important factor in reducing the potential harms associated with cannabis.

Canadian youth cite a range of motivations for using cannabis, including for social reasons, as a form of coping or self-medication, and for the pleasure derived from the characteristic “high” or euphoric sensation brought on by the consumption of the dominant psychoactive cannabinoid, THC (Δ^9 -tetrahydrocannabinol) (Patrick et al., 2011; Porath-Waller et al., 2013; Bonn-Miller and Zvolensky, 2009; Shrier and Scherer, 2014; Buckner et al., 2007). Other reasons provided include pain relief, anxiety, or depression (Statistics Canada, n.d.). Research has

* Corresponding author.

E-mail addresses: cesar.leos-toro@uwaterloo.ca (C. Leos-Toro), vrynard@uwaterloo.ca (V. Rynard), dmurnaghan@tru.ca (D. Murnaghan), jamacdonald@upei.ca (J.-A. MacDonald), dhammond@uwaterloo.ca (D. Hammond).

<https://doi.org/10.1016/j.ypmed.2018.10.002>

Received 23 April 2018; Received in revised form 3 October 2018; Accepted 8 October 2018

Available online 11 October 2018

0091-7435/ © 2018 Published by Elsevier Inc.

Table 1
Weighted sample characteristics Canadian Student Tobacco, Alcohol and Drugs Survey, 2004 to 2015, Canada.

	2004/2005	2006/2007	2008/2009	2010/2011	2012/2013	2014/2015
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
	(n = 16,705)	(n = 58,353)	(n = 45,425)	(n = 44,852)	(n = 41,057)	(n = 36,665)
Gender						
Female	48.5%	48.6%	48.6%	48.5%	48.6%	48.6%
Male	51.5%	51.4%	51.4%	51.5%	51.4%	51.4%
Grade						
Grade 7	33.7%	16.6%	16.2%	16.2%	16.0%	15.9%
Grade 8	33.2%	17.2%	16.6%	16.5%	16.6%	16.1%
Grade 9	33.2%	17.4%	17.1%	16.8%	17.3%	17.2%
Grade 10	^b	17.2%	17.5%	17.3%	17.2%	17.2%
Grade 11	^b	16.6%	17.1%	17.2%	17.2%	17.4%
Grade 12	^b	15.0%	15.6%	16.0%	15.8%	16.3%
Ethnicity						
Aboriginal	4.1%	8.1%	7.6%	5.6% ^a	5.0% ^a	4.4%
Non-Aboriginal	95.9%	91.9%	92.4%	94.4%	95.0%	95.6%
Region						
British Columbia	11.8%	12.6%	14.0%	14.4%	13.1%	12.6%
Alberta	11.2%	11.0%	11.8%	11.8%	11.3%	11.1%
Saskatchewan	3.3%	3.5%	3.3%	3.2%	3.2%	3.1%
Manitoba	3.6%	3.8%	3.9%	3.9%	^b	3.9%
Ontario	38.6%	42.2%	41.0%	42.7%	45.7%	44.4%
Quebec	23.9%	19.5%	19.0%	19.2%	19.5%	18.3%
Newfoundland & Labrador	1.6%	1.6%	1.5%	1.5%	1.4%	1.3%
New Brunswick	2.4%	2.4%	2.3%	^b	2.6%	^b
Nova Scotia	2.9%	2.8%	2.7%	2.8%	2.7%	2.6%
Prince Edward Island	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%

^a Moderate sampling variability meaning coefficient of variation from 16.6% to 33.3%, interpret with caution as recommended in the CSTADS User Guide.

^b The 2004/05 Youth Smoking Survey did not collect data from youth and Grades 10 to 12. Furthermore, in 2010/2011 New Brunswick did not participate and the 2014/15 CSTADS does not include a generalizable sample of students from the province of New Brunswick. As a result, data for New Brunswick students could not be used to produce provincial estimates. Manitoba did not participate in the 2012/2013 survey wave.

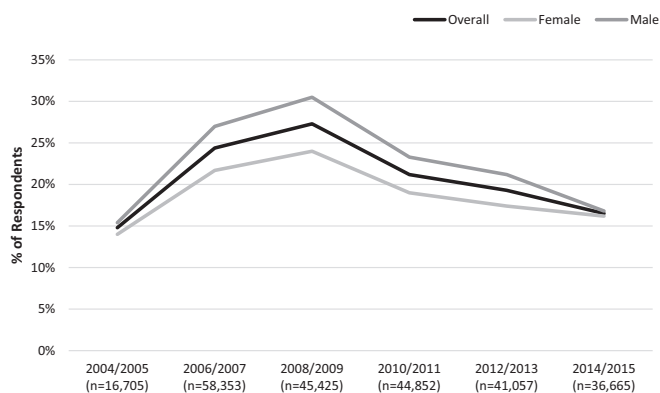


Fig. 1. Past 12-month cannabis use reported among youth (Grades 7 to 12) across Canada, 2004 to 2015.

highlighted the importance of attitudes and beliefs as important predictors of use among youth, such as perceptions of risk (Hall et al., 2016; McKiernan and Fleming, 2017; Alhyas et al., 2015; Hannah et al., 2017). Access to cannabis—and the perception that cannabis is easily available are particularly important risk factors (Warren et al., 2015; Connell et al., 2010). US data suggests that visibility and ubiquity in young people's social context of particular substances such as cannabis increased likelihood of perceived access to it (Warren et al., 2015).

To date, there are relatively little data on trends in cannabis use over time among Canadian youth. A recent report from Statistics Canada estimated that the overall prevalence of past 12-month use of cannabis increased from 5.6% to 12.5% between 1985 and 2015; however, the comparability of these estimates is unclear given the variety of data sources and methodologies (Rotermann and Macdonald, 2018; Freeman et al., 2016). Canadian Health Behaviour in School-aged Children Study data from grade 10 students found that 'lifetime use' of

cannabis increased from 1990 to 2002, when it peaked at 45%, before declining to 38% in 2006 (Elgar et al., 2011). The Youth Smoking Survey, found that cannabis use among grade 7 to 9 students was stable between 2002 and 2008 at approximately 20% 'lifetime use' (Hammond et al., 2011). Data from the Ontario Student Drug Use and Health Survey indicates that past year use of cannabis has remained stable at approximately 21% between 2013 and 2015, after a general decline since 1990 (Boak et al., 2015). To date, efforts to examine trends over time in cannabis use have been limited to descriptive summaries of data, often from surveys with inconsistent tools and methods (Macdonald and Rotermann, 2018).

In the US, data from the National Survey on Drug Use and Health indicates that cannabis use has increased between 2005 and 2014 among youth aged 12 to 17 (Schauer and Peters, 2018). According to the Monitoring the Future Study, daily cannabis use increased among US youth in grades 8, 10 and 12 after 2007, peaking in 2011 thereafter declining slightly (Johnston et al., 2018). The European School Survey Project on Alcohol and Other Drugs found that cannabis use among youth aged 15 and 16 years increased between 1999 and 2015 in the Balkans and Southern Europe (Kraus et al., 2018). In contrast, the most recent analyses among Australian school-aged youth (Grade 5 to 11) from 1999 to 2015 found reductions in cannabis use across time (Toumbourou et al., 2018).

Understanding trends in cannabis use are particularly important in Canada, given that non-medical cannabis will be legalized in October 2018, with a primary objective of reducing access to youth. The current study examined national trends in cannabis use among Canadian youth over the past 10 years, using nationally representative data from the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS). In particular, the current study sought to characterize potential changes in the prevalence of cannabis use, age of initiation, of the perceived 'ease of access' for cannabis, as well as key sociodemographic correlates of changes over time.

Table 2
Past 12-month cannabis use among youth (Grades 7 to 12), 2004 to 2015, Canada.

	2004/2005 (n = 16,705)	2006/2007 (n = 58,353)	2008/2009 (n = 45,425)	2010/2011 (n = 44,852)	2012/2013 (n = 41,057)	2014/2015 (n = 36,665)
Overall	14.8%	24.4%	27.3%	21.2%	19.3%	16.5%
Gender						
Female	14.0%	21.7%	24.0%	19.0%	17.4%	16.2%
Male	15.4%	27.0%	30.5%	23.3%	21.2%	16.8%
Grade						
Grade 7	5.8%	4.1%	4.6%	2.8%	3.2%	1.2% ^a
Grade 8	12.8%	12.2%	13.4%	8.9%	7.1%	4.7%
Grade 9	25.3%	23.2%	25.0%	17.1%	15.4%	10.9%
Grade 10	^b	31.0%	32.1%	25.8%	23.0%	19.2%
Grade 11	^b	37.7%	42.2%	32.1%	31.2%	28.5%
Grade 12	^b	37.1%	44.4%	38.9%	35.6%	33.0%
Ethnicity						
Aboriginal	32.0%	39.4%	43.6%	39.5%	34.1%	36.7%
Non-Aboriginal	14.1%	23.4%	26.3%	20.2%	18.6%	15.7%
Region						
British Columbia	13.1% ^a	34.5%	41.8%	29.5%	17.5%	20.3%
Alberta	11.6%	13.2% ^a	19.3%	21.8%	16.5%	11.5%
Saskatchewan	11.5% ^a	22.6%	28.6%	18.5% ^a	22.3%	17.9% ^a
Manitoba	^c	27.3% ^a	18.4%	23.2%		24.3% ^a
Ontario	11.2%	22.6%	26.2%	17.6%	18.5%	16.1%
Quebec	23.9%	27.4%	27.1%	21.6%	21.7%	15.6%
Newfoundland & Labrador	14.2%	23.3%	25.9%	24.1%	20.6%	22.3%
New Brunswick	13.0% ^a	24.6%	24.8%	^b	27.1%	^b
Nova Scotia	17.9%	29.6%	25.0%	30.5%	24.0%	22.2%
Prince Edward Island	6.9% ^a	20.4%	17.9%	18.8%	20.7%	24.8%

^a Moderate sampling variability meaning coefficient of variation from 16.6% to 33.3%, interpret with caution as recommended in the CSTADS User Guide.

^b The 2004/05 Youth Smoking Survey did not collect data from youth and Grades 10 to 12. In 2010/2011 New Brunswick did not participate. In 2014/15 New Brunswick did participate, however, a generalizable sample of students from the province of was not included; as a result, data for New Brunswick students could not be used to produce provincial estimates in 2014/15. Manitoba did not participate in the 2012/2013 survey wave.

^c Estimate suppressed as per CSTADS User Guide due to sampling variability in excess of 33.3% or number of respondents < 30.

2. Methods

2.1. Design

The Youth Smoking Survey—renamed the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS) in 2014/15—is a biennial survey of school-aged children in Grades 6 through 12 which used a repeat-cross sectional survey design to collect nationally generalizable data on behalf of Health Canada between 2004 and 2014 (Burkhalter et al., 2018). (For simplicity, we will refer to all cycles as CSTADS.) In 2004, school boards were sampled within each province and then schools were randomly sampled from the sampled school boards. Since 2006, a stratified single stage cluster design with strata based on health region smoking rate and type of school has been used. In each of the 10 Canadian provinces, two or three health region smoking rate strata and two school-level strata were defined. Yukon, the Northwest Territories, and Nunavut have never been part of the sample frame for the survey. Random selection of schools within each stratum ensured a generalizable sample of schools for each province.

Trained research staff in each province recruited and implemented the survey at the school board, school, and individual student levels. Consistent with school board requirements, parents provided permission for their child to participate in the study via active parent permission or active information-passive permission protocols. Only students with parental permission were invited to participate in the study on the day of survey implementation. Students could opt out at any time. At each survey cycle, ethics approval was ascertained from research ethics boards at Health Canada, the University of Waterloo, and institutions and school boards in each participating province.

A total of 292,414 students participated in CSTADS since 2004. Teachers administered the paper questionnaire in classroom settings between October and June of each school year. On the day of a school's data collection, classroom teachers followed standard and detailed project instructions to administer the paper questionnaire during a

designated class period. Questionnaire administration, including instructions to the students, required 20–30 min within each class. To protect confidentiality, teachers avoided circulating within the classroom while students completed the questionnaire, and students placed their completed questionnaire in a sealable envelope before handing it to a fellow student who returned classroom sets to a central location (e.g., school office). Using Optimal Mark Recognition technology and quality-control procedures, the Propel Centre for Population Health Impact at the University of Waterloo produced final data files for CSTADS. Across all cycles of the survey, the response rate ranged between 55 and 73% of the eligible student population in participating classes. Detailed information on the surveys' methodology, sampling design, and survey rates may be found through Health Canada or the survey website (<https://uwaterloo.ca/canadian-student-tobacco-alcohol-drugs-survey/>) (Burkhalter et al., 2018; Health Canada, 2018; Rynard et al., 2014/2015).

2.2. Participants

Since 2006, the target population for the biennial CSTADS has included Canadian students in grades 6 to 12 (6 to secondary V in Quebec) attending private, public, and Catholic schools in all 10 Canadian provinces, excluding New Brunswick in 2010/11, 2014/15 and Manitoba in 2012/13. With the exception of these provincial exclusions, CSTADS achieved a generalizable sample in all cycles at national- and provincial-levels. Comparative analyses revealed that there were no statistically significant differences in national estimates without these provinces (Burkhalter et al., 2012/2013). The current analysis is limited to students in grades 7–12 given that students in lower grades were not asked questions on alcohol and drug use.

2.3. Measures

Sociodemographic characteristics were collected in all of the survey

Table 3
 Logistic regression analyses examining factors associated cannabis use behaviours among youth (Grades 7 to 12) from 2004/2005 to 2014/2015, Canadian Student Tobacco, Alcohol and Drugs Survey, Canada.

	Ref category	Model 1 – ‘Past 12-month’ cannabis use		Model 2 – ‘Easy’ access to cannabis	
		OR	Adj 95% CI	OR	Adj 95% CI
Gender					
Male	Female	1.30	(1.19–1.42)	1.17	(1.08–1.27)
Grade					
Grade 8	Grade 7	2.98	(2.47–3.60)	2.42	(2.04–2.87)
Grade 9		6.79	(5.57–8.27)	5.63	(4.68–6.77)
Grade 10		11.03	(9.08–13.39)	10.68	(8.93–12.77)
Grade 11		16.78	(13.72–20.52)	15.23	(12.12–19.15)
Grade 12		22.54	(18.08–28.10)	23.61	(18.31–30.56)
Ethnicity					
Aboriginal	Non-Aboriginal	2.64	(2.40–2.91)	1.64	(1.41–1.91)
Region					
British Columbia	Ontario	1.52	(1.18–1.97)	1.22	(0.87–1.70)
Alberta		0.79	(0.53–1.16)	0.87	(0.65–1.16)
Saskatchewan		0.97	(0.72–1.31)	0.96	(0.72–1.29)
Manitoba		1.00	(0.68–1.47)	0.86	(0.53–1.38)
Quebec		1.91	(1.60–2.29)	1.69	(1.29–2.22)
Newfoundland & Labrador		1.24	(0.94–1.62)	1.88	(1.44–2.46)
New Brunswick		1.20	(1.02–1.42)	1.50	(1.14–1.97)
Nova Scotia		1.58	(1.32–1.89)	1.82	(1.40–2.37)
Prince Edward Island		1.03	(0.80–1.33)	1.17	(0.87–1.59)
Survey year					
2006/2007	2004/2005	0.73	(0.57–0.94)	1.19	(0.89–1.59)
	2008/2009	0.85	(0.69–1.05)		
	2010/2011	1.22	(0.97–1.54)		
	2012/2013	1.37	(1.08–1.73)		
	2014/2015	1.69	(1.37–2.09)		
2008/2009	2004/2005	0.86	(0.66–1.13)	2.52	(1.99–3.19)
	2010/2011	1.44	(1.17–1.77)		
	2012/2013	1.61	(1.23–2.11)		
2010/2011	2004/2005	2.00	(1.61–2.47)	4.09	(3.30–5.08)
	2012/2013	0.60	(0.46–0.79)		
	2014/2015	1.12	(0.84–1.48)		
2012/2013	2004/2005	1.39	(1.11–1.73)	0.47	(0.36–0.62)
	2014/2015	0.54	(0.41–0.70)		
	2004/2005	1.24	(0.97–1.58)		
2014/2015	2004/2005	0.43	(0.33–0.56)	1.62	(1.30–2.02)
	2004/2005	0.29	(0.22–0.38)		

Note: Data was not collected for Ease of Access measure in 2008/2009 and 2010/2011 Survey waves.

waves from 2004/2005 to 2014/2015 including: sex, grade, self-identified Aboriginal status, and province of residence. Patterns of cannabis use were assessed with the question, “In the past 12 months how often did you use marijuana or cannabis? (a joint, pot, weed, hash...)” (‘Past 12-month’ use) with responses, 0 = I have never used marijuana, 1 = I have used marijuana but not in the last 12 months, 2 = Less than once a month, 3 = Once a month, 4 = 2 or 3 times a month, 5 = Once a week, 6 = 2 or 3 times a week, 7 = 4 to 6 times a week, 8 = Every day, 9 = I don’t know or 99 = Refuse to answer. ‘Age of initiation’ of cannabis use was assessed using the question, “How old were you when you first used marijuana or cannabis?” with response options, 0 = I have never used marijuana, 2 = I do not know, 3 = 8 years or younger, 4 = 9 years, 5 = 10 years... 12 = 17 years, 13 = 18 years or older, 99 = Refuse to answer. ‘Ease of Access’ to cannabis was assessed through the question, “How difficult do you think it would be for you to get each of the following types of drugs, if you wanted some? (a) Marijuana or cannabis (a joint, pot, weed, hash...)” with response options, 1 = Probably impossible, 2 = Very difficult, 3 = Fairly difficult, 4 = Fairly easy, 5 = Very easy, 6 = I do not know, 99 = Refuse to answer.

2.4. Analysis

SAS Software for Windows Version 9.4 (Cary, NC: SAS Institute Inc.) was used for all analyses. Descriptive analyses are presented for each of the six survey cycles. Data was available on all measures at all waves, with the exception that the 2004/2005 wave did not include grades 10

to 12 in its sample frame. In addition, the ‘ease of access’ measure was not included in the 2008/2009 or 2010/2011 cycles. Two logistic regression models were fitted to test changes over time, as well as correlates associated with each primary outcome: past 12-month use and ease of access. A linear regression was conducted to examine age of initiation across the six survey waves available spanning 10 years. Five independent variables were entered in each model: gender, grade, Aboriginal status, province of residence, and survey year which was treated as a categorical variable. Twelve two-way interaction terms between survey year and each covariate were tested in the model to examine changes across socio-demographic variables, significant interactions are presented in text as appropriate. Survey weights were used to adjust for sample selection (school and class levels), non-response (school, class and student levels) and poststratification of the sample population relative to grade and sex distribution in the total population. Bootstrap weights were used to calculate CIs of the prevalence estimates and regression analyses, accounting for the effects of survey design on variance estimates. All estimates reported in the paper are weighted, and ‘adjusted odds ratios’ (AORs) are reported from the regression models, unless otherwise noted. Accepted significance of results was set at $p < 0.05$, and a Bonferroni correction was applied to reduce risk of Type I error (SAS Institute Inc., 2018).

Table 4
Perceiving ease of access to cannabis among youth (Grades 7 to 12), 2004 to 2015, Canada.

	2004/2005 (n = 16,705)	2006/2007 (n = 58,353)	2012/2013 (n = 41,057)	2014/2015 (n = 36,665)
	%n	%n	%n	%n
Overall	55.4%	77.1%	59.3%	49.0%
Gender				
Female	53.4%	75.2%	57.6%	48.0%
Male	57.3%	78.9%	61.0%	49.9%
Grade				
Grade 7	32.5%	38.4%	20.4%	12.0%
Grade 8	55.0%	61.0%	35.0%	24.4%
Grade 9	73.5%	78.4%	55.9%	42.9%
Grade 10	^a	85.4%	71.2%	59.5%
Grade 11	^a	89.5%	77.1%	67.6%
Grade 12	^a	89.4%	82.2%	77.1%
Ethnicity				
Aboriginal	62.2%	79.5%	69.4%	66.2%
Non-Aboriginal	54.8%	77.3%	58.9%	48.3%
Region				
British Columbia	55.0%	83.8%	57.6%	53.7%
Alberta	53.3%	71.7%	55.8%	40.3%
Saskatchewan	49.0%	73.9%	61.7%	47.6%
Manitoba	36.4% ^b	72.0%	^a	60.0%
Ontario	46.7%	74.5%	59.3%	50.2%
Quebec	72.1%	80.4%	58.0%	42.7%
Newfoundland & Labrador	59.3%	81.6%	71.2%	62.4%
New Brunswick	50.7%	79.3%	70.8%	^a
Nova Scotia	63.0%	82.3%	70.2%	60.3%
Prince Edward Island	39.3%	74.6%	62.4%	56.5%

^a The 2004/05 Youth Smoking Survey did not collect data from youth and Grades 10 to 12. In 2010/2011 New Brunswick did not participate. In 2014/15 New Brunswick did participate, however, a generalizable sample of students from the province of was not included; as a result, data for New Brunswick students could not be used to produce provincial estimates in 2014/15. Manitoba did not participate in the 2012/2013 survey wave.

^b Moderate sampling variability meaning coefficient of variation from 16.6% to 33.3%, interpret with caution as recommended in the CSTADS User Guide.

3. Results

3.1. Sample characteristics

After removing respondents in grades < 7, a sample of 243,057 respondent records was analyzed. Across survey cycles, there was similar representation in terms of gender, grade level, Aboriginal identity, and province of residence. An important difference worth mentioning is that the 2004/2005 survey wave did not collect data for senior high school grades 10 through 12. Weighted sample characteristics are presented in Table 1 with further detail.

3.2. Prevalence of cannabis use in the past 12-months

Fig. 1 and Table 2 present ‘use in the past 12-months’ across survey cycles. In 2006/2007, approximately one-quarter (24.4%) of youth in Grades 7 to 12 reported ‘past 12-month’ use; by 2014/2015, it declined to 16.5%. As the findings from the regression model shown in Table 3 indicate, there was a significant decrease from 2006/2007 to 2014/2015 in reported rates of ‘past 12-month’ use. Respondents in 2006/2007 were > 1.5 times (AOR = 1.69 95% CI 1.37–2.09) more likely to report ‘past 12-month’ use than those in 2014/2015.

Males were more likely than females to report cannabis use (AOR = 1.3 95% CI 1.19–1.42). Increasing grade level was associated with a greater likelihood of having reported cannabis use than the preceding grade level (e.g., respondents in Grade 12 were much more likely to have reported use than respondents in Grade 7). Youth who self-identified as Aboriginal were approximately 3 times more likely to report ‘past 12-month’ cannabis use. Regional differences were also detected: Quebec youth had the highest odds of using cannabis, followed by British Columbia and Nova Scotia while Alberta had the lowest odds followed by Saskatchewan, Manitoba, Ontario, and Prince Edward Island. Further detail is displayed in Table 3. From the interaction models, across survey years, sex ($F_{5,500} = 4.02, p = 0.001$),

grade level ($F_{22,500} = 1.95, p = 0.006$), and region of residence ($F_{43,500} = 9.74, p < 0.001$) contributed to changes in reported ‘past 12-month’ use. Reported ‘past 12-month’ use decreased across survey cycles among both sexes, across grade levels (although more in the lower grades), as well as most provinces with the exception of Saskatchewan, Manitoba and Newfoundland and Labrador where there were no significant changes and Prince Edward Island where there was an increase.

3.3. Perceived ease of access to cannabis

Perceived ease of access to cannabis is presented in Table 4. (Note, data for this measure were not collected in 2008/2009 or 2010/2011.) Approximately half of youth reported that it was ‘easy’ to access cannabis across all survey years; the highest proportion of youth reporting ‘easy’ access in 2006/2007 (77.1%), with the lowest proportions in 2014/2015 (49.0%). As indicated in logistic regression analysis shown Table 3 (see Model 2), youth were significantly less likely (AOR = 0.29 95% CI 0.22–0.38) to have reported ‘easy’ access to cannabis in 2014/2015 compared to youth responses from 2004/2005. Males were more likely than females to report ‘easy’ to access cannabis across years (AOR = 1.17 95% CI 1.08–1.27 in 2014/2015). Similar to the other models examined in the current study, higher school grade levels were associated with a greater likelihood that students reported ‘easy’ access to cannabis, with substantially greater odds with each additional year. Respondents who self-identified as Aboriginal were more likely to report ‘easy’ access to cannabis and similar regional differences were detected as with prevalence of use. From the interaction models, across years, Aboriginal identity ($F_{3,500} = 3.65, p = 0.013$) and region of residence ($F_{26,500} = 6.26, p < 0.001$) were correlated with changes in perceptions of ease of access. Perceptions of ease of access decreased among non-Aboriginal youth across all survey cycles that included all grade levels (AOR = 1.64 95% CI 1.41–1.91). Aboriginal youth’s perceived ease of access also decreased from 2006/07, however, reported

perceptions of access ease did not change significantly between 2012/13 and 2014/15. All provinces experienced decreases in perceived ease of access to cannabis across years.

3.4. Mean age of initiation of cannabis use

Overall, a weighted mean age of initiation of 13.8 years was found for youth who had ever used cannabis across survey cycles. The multiple linear regression model that examined age of initiation produced significant results in all but two measures, *gender* and *Aboriginal status*. The results indicate that the model accounted for 21.3% of the variance ($R^2 = 0.213$, $p < 0.0001$). It was found that mean age of initiation increased ($F_{5,500} = 457.78$, $p < 0.0001$) with subsequent grade levels. Respondents' province of residence was significantly ($F_{9,500} = 10.55$, $p < 0.0001$) associated with relatively precocious or delayed initiation. Youth in Alberta reported a significantly greater ($t = 4.51$, $p_{adj} = 0.0004$) mean age of initiation than youth in British Columbia. Youth in British Columbia were more likely to report an earlier age of initiating cannabis use than their peers in Saskatchewan ($t = -6.48$, $p_{adj} < 0.001$), Quebec ($t = -3.99$, $p_{adj} = 0.0034$), and Nova Scotia ($t = -4.32$, $p_{adj} = 0.0008$). There were no statistically significant differences in the reported mean age of initiation between survey cycles.

4. Discussion

Despite the common perception that cannabis use is increasing among young people, nationally representative findings from Canada's 'benchmark' survey indicate that cannabis use among youth peaked in 2008/09 and generally decreased thereafter. It is promising that the most recent estimates of 'past 12-month' use are lower than at any point since 2006/07, when data was first available across all high school years, at 16.5%. These findings are consistent with the most recent analyses of a variety of nationally representative surveys of cannabis use conducted by Health Canada, as well as the decreasing trends identified by the most recent years of the Ontario Drug Use and Health Survey and the HBSC surveys (Rotermann and Macdonald, 2018; Freeman et al., 2016; Centre for Addictions and Mental Health, 2017; <http://www.hbsc.org/publications/journal/>, 2018). Similarly, recent work by Mauro and colleagues also suggests that cannabis use among US adolescents has been decreasing since 2007 (Mauro et al., 2018).

The findings indicate substantial variation across provinces in the prevalence of cannabis use among youth. Indeed, estimates of past 12-month use are double in some provinces compared to provinces such as Alberta, which had the lowest rate of use. It is unclear whether provincial differences reflect different substance use prevention efforts or other factors. Currently, there exists little empirical evidence on provincial level changes that may account for within and between provincial differences in cannabis use; there exists no information on differences in availability of cannabis, the scope of the illicit market, or clear indications from adult trends that may provide a compelling argument for these differences to date. This highlights the need for enhanced monitoring of the cannabis market and potential determinants of cannabis use among youth. Given that provinces are establishing very different retail frameworks for cannabis legalization—with important differences in the number and type of 'brick-and-mortar' retail outlets, online retail access, and different minimum age restrictions—future studies should monitor provincial trends more closely.

Males reported greater use and access to cannabis than females. However, differences between male and female youth have narrowed over time; it has previously been reported that 2014/2015 was the first year on record where females were just as likely to report cannabis use in the past 12-months as males (Leos-Toro et al., n.d.). The lack of sex differences on these measures may be a reflection of a cultural shift regarding cannabis use among female youth within a national context that is in the process of liberalizing policies related to cannabis use, a

diminishing trend in stigma associated with reporting use, or perhaps both. Youth who self-identified as Aboriginal were also more likely to report greater cannabis use, similar to other previous findings (Grant and Belanger, 2017). The lack of data on substance use among Aboriginal Canadians represents a major gap. The last time temporal trends were examined among this population, cannabis use was found to double among Inuit youth from 38% in 1992 to nearly 78% in 2004 among the population in Northern Quebec (Fortin et al., 2015). There is an urgent need for better surveillance and monitoring of substance use among Aboriginal groups in Canada, particularly given that most major national surveys do not include the Territories or on-reserve First Nation peoples.

The current study did not assess the underlying factors that may be associated with population-level changes in substance use; though ease of access was examined with the core set of covariates used for cannabis use measures (ter Bogt et al., 2006). Fewer Canadian youth reported that cannabis was 'easy' access to cannabis in recent years, consistent with trends from the United States (Azofeifa et al., 2016). Perceived ease of access is an important predictor of substance use initiation of use (Richmond-Rakerd et al., 2015; Degenhardt et al., 2010), and the declines observed in the current study are consistent with the downward trend in cannabis use. The findings are nevertheless surprising and somewhat counter to the anecdotal evidence on greater access to cannabis. For example, Canada has seen an increase in the number of illegal 'dispensaries' and online cannabis retailers in Canada; however, the extent to which these sources enforce a minimum age restriction is unclear (Mahamad and Hammond, 2018). Future research should examine the extent to which perceived access among youth changes following cannabis legalization and its role, if any, in cannabis use among young people.

The mean age of initiation was stable over time, consistent with trends in the United States, where mean age at first use did not change significantly between 2002 and 2014 among US youth aged 12–17 (Azofeifa et al., 2016). Delaying the onset of cannabis use represents an important harm reduction measure, given that early initiation is among the strongest predictors of problematic use (Hall et al., 2016; George and Vaccarino, 2015; Brook et al., 1999).

4.1. Study limitations and strengths

Cross-sectional surveys are subject to a number of common limitations. Despite being nationally representative, the CSTADS only included students attending private, public, and Catholic schools which excluded youth living on First Nations Reserves, those attending special schools (e.g., school for the visually impaired), schools on military bases, among other kinds of schools and captured respondents who attended school during the day of the survey potentially excluding youth of interest. Weighting was applied to help account for non-response; however, it is possible that the data used to generate weights may not be representative of populations who use cannabis with risks of over or underestimating prevalence measures. In addition, the sample design of CSTADS varied over time: certain survey cycles did not include certain provinces, and the 2004/2005 survey cycle did not include youth in Grades 10 to 12. Additionally, there existed large periods of time where the survey may have been administered at each wave (October to June) which may have affected estimates of cannabis use given differential experiences among youth throughout the school year. Self-reporting of substance use measures may be subject to social desirability bias, has the potential to underestimate prevalence of use among youth as participants may be reluctant to disclose use due to illegality, stigma, or concerns about privacy of responses; however, one would expect any biases to be relatively constant over time, such that they would not account for trends. Finally, retrospective reporting of age of first use is also subject to recall error. Despite these limitations, CSTADS remains the benchmark survey in Canada for assessing substance use among youth.

5. Conclusion

Cannabis use among Canadian youth appears to have peaked around 2008/09, with substantial declines over the past decade. It will be critically important to examine any changes in patterns of use following legalization of non-medical cannabis in 2018. There is a particular need for measures that examine more frequent patterns of use (such as daily or weekly use), as well as different forms of use. For example, anecdotal evidence suggests that the ‘forms’ of cannabis use have diversified, with an increase in the use of cannabis oils and high potency extracts. This diversification is likely to accelerate following legalization and may have important implications for indicators of problematic use among youth (Wall et al., 2016; Williams and Bretteville-Jensen, 2014). The current study is among the first to investigate trends of cannabis use among Canadian youth over the past decade and will serve as a useful benchmark to determine effectiveness of future interventions on cannabis use prevalence measures that have shown reductions in the past 10 years.

Conflicts of interest

None to declare.

Funding

This work was supported by a Canadian Institutes of Health Research Public Health Agency of Canada Chair in Applied Public Health (DH) and by the Canadian Cancer Society grant #2011-701019, and #2017-704507 through the Propel Centre for Population Health Impact.

Data used for this research were taken from Health Canada's Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS), which was conducted for Health Canada by the Propel Centre for Population Health Impact at the University of Waterloo. Health Canada has not reviewed, approved, nor endorsed this research. Any views expressed, or conclusions drawn herein do not necessarily represent those of Health Canada.

References

- Alhyas, L., Al Ozaibi, N., Elarabi, H., El-Kashef, A., Wanigaratne, S., Almarzouqi, A., Al, Ghaferi H., 2015. Adolescents' perception of substance use and factors influencing its use: a qualitative study in Abu Dhabi. *J. R. Soc. Med. Open* 6 (2), 1–12. <https://doi.org/10.1177/2054270414567167>.
- Azofeifa, A., Mattson, M., Schauer, G., McAfee, Grant A., Lyerla, R., 2016. National estimates of marijuana use and related indicators – National Survey on Drug Use and Health, United States, 2002–2014. *MMWR Surveill. Summ.* 65 (11), 1–25. From: <https://www.cdc.gov/mmwr/volumes/65/ss/ss6511a1.htm>, Accessed date: 8 July 2018 (Table 6: Percentage of past year marijuana initiation among persons aged ≥ 12 years at risk for initiation, * estimated number at risk for initiation, and mean age at first use of marijuana among past year initiators, by age group — National Survey on Drug Use and Health, United States, 2002–2014).
- Boak, A., Hamilton, H.A., Adlaf, E.M., Mann, R.E., 2015. Drug use among Ontario students, 1977–2015: detailed OSDUHS findings. In: CAMH Research Document Series No. 41. Centre for Addictions and Mental Health, Toronto, ON From: http://www.camh.ca/en/research/news_and_publications/ontario-student-drug-use-and-health-survey/Documents/2015%20OSDUHS%20Documents/2015OSDUHS_Detailed_DrugUseReport.pdf, Accessed date: 11 December 2017.
- Bonn-Miller, M.O., Zvolensky, M.J., 2009. An evaluation of the nature of marijuana use and its motives among young adult active users. *Am. J. Addict.* 18 (5), 409–416. <https://doi.org/10.3109/10550490903077705>.
- Brook, J.S., Balka, E.B., Whiteman, M., 1999. The risks for late adolescence of early adolescent marijuana use. *Am. J. Public Health* 89 (10), 1549–1554. <https://doi.org/10.2105/AJPH.89.10.1549>.
- Buckner, J.D., Bonn-Miller, M.O., Zvolensky, M.J., Schmidt, N.B., 2007. Marijuana use motives and social anxiety among marijuana-using young adults. *Addict. Behav.* 32, 2238–2252. <https://doi.org/10.1016/j.addbeh.2007.04.004>.
- Burkhalter, R., Cumming, T., Rynard, V., Manske, S., 2012/2013. Youth Smoking Survey Microdata User Guide. Propel Centre for Population Health Impact, University of Waterloo, Waterloo, ON, pp. 1–47 (2013).
- Burkhalter, R., Cumming, T., Rynard, V., Schonlau, M., Manske, S., 2018. Research Methods for the Canadian Student Tobacco, Alcohol and Drugs Survey, 2010–2015. Propel Centre for Population Health Impact, University of Waterloo, Waterloo, Ontario (Accessed on July 19, 2018 from: [sites/ca.canadian-student-tobacco-alcohol-drugs-survey/files/uploads/files/report_researchmethodsctads_20180417.pdf](https://sites.ca.canadian-student-tobacco-alcohol-drugs-survey/files/uploads/files/report_researchmethodsctads_20180417.pdf)).
- Centre for Addictions and Mental Health, 2017. Drug Use Among Ontario Students – Long Term Trends 1977–2017. From: <http://www.camh.ca/Publications/OSDUHS/2017/index.html>, Accessed date: 7 March 2018.
- Connell, C.M., Gilreath, T.D., Aklin, W.M., Brex, R.A., 2010. Social-ecological influences on patterns of substance use among non-metropolitan high school students. *Am. J. Community Psychol.* 45 (1–2), 323–330. <https://doi.org/10.1007/s10464-009-9289-x>.
- Degenhardt, L., Dierker, L., Chiu, W.T., Medina-Mora, M., et al., 2010. Evaluating the drug use “gateway” theory using cross-national data: consistency and associations of the order of initiation of drug use among participants in the WHO World Mental Health Surveys. *Drug Alcohol Depend.* 108 (1–2), 84–97. <https://doi.org/10.1016/j.drugalcdep.2009.12.001>.
- Elgar, F.J., Phillips, N., Hammond, N., 2011. Trends in alcohol and drug use among Canadian adolescents, 1990–2006. *Can. J. Psychiatr.* (4), 243–247. <https://doi.org/10.1177/070674371105600408>.
- Fergusson, D.M., Boden, J.M., 2008. Cannabis use and later life outcomes. *Addiction* 103, 969–976. <https://doi.org/10.1111/j.1360-0443.2008.02221.x>.
- Fortin, M., Belanger, R.E., Boucher, O., Mucle, G., 2015. Temporal trends of alcohol and drug use among Inuit of Northern Quebec, Canada. *Int. J. Circumpolar Health* 74. <https://doi.org/10.3402/ijch.v74.29146>.
- Freeman, J., King, M., Pickett, W., 2016. Health Behaviour in School-aged Children (HBSC) in Canada: focus on relationships. From: Public Health Agency of Canada <http://healthy Canadians.gc.ca/publications/science-research-sciences-recherches/health-behaviour-children-canada-2015-comportements-sante-jeunes/alt/health-behaviour-children-canada-2015-comportements-sant%C3%A9-jeunes-eng.pdf>, Accessed date: 27 August 2018.
- George, T., Vaccarino, F. (Eds.), 2015. Substance Abuse in Canada: The Effects of Cannabis use during Adolescence. Canadian Centre on Substance Abuse, Ottawa, ON From: <http://www.ccsa.ca/Resource%20Library/CCSA-Effects-of-Cannabis-Use-during-Adolescence-Report-2015-en.pdf>, Accessed date: 20 December 2016.
- Government of Canada, 2016a. Summary results for 2015 Canadian Tobacco, Alcohol and Drugs Survey. From: <http://healthy Canadians.gc.ca/science-research-sciences-recherches/data-donnees/ctads-ectad/summary-sommaire-2015-eng.php>, Accessed date: 20 December 2016.
- Government of Canada, 2016b. Summary of results Canadian Student Tobacco, Alcohol and Drugs Survey 2014–2015. From: <http://healthy Canadians.gc.ca/science-research-sciences-recherches/data-donnees/ctads-ectade/summary-sommaire-2014-15-eng.php>, Accessed date: 20 December 2016.
- Grant, C.N., Belanger, R.E., 2017. Cannabis and Canada's children and youth. *Paediatr. Child Health* 22 (2), 98–102. <https://doi.org/10.1093/pch/pxx017>.
- Hall, W., Renstrom, M., Poznyak (Eds.), 2016. The Health and Social Effects of Nonmedical Cannabis Use. World Health Organization, Geneva 978 92 4 151024 0, From: http://www.who.int/substance_abuse/publications/msb_cannabis_report.pdf, Accessed date: 11 November 2017.
- Hammond, D., Ahmed, R., Sae Yang, W., Brukhalter, R., Leatherdale, S., 2011. Illicit substance use among Canadian youth: trends between 2002 and 2008. *Can. J. Public Health* 102 (1), 7–12. <https://doi.org/10.17269/cjph.102.2268>.
- Hannah, R.C., Perez, J.M., Ghose, S., 2017. Cannabis and development of dual diagnoses: a literature review. *Am. J. Drug Alcohol Abuse* 43 (4), 442–455. <https://doi.org/10.1080/00952990.2016.1213273>.
- Health Canada, 2018. Canadian Student Alcohol and Drugs Survey. From: <https://www.canada.ca/en/health-canada/services/canadian-student-tobacco-alcohol-drugs-survey.html>, Accessed date: 18 July 2018.
- Health behaviour in school-aged children – World Health Organization collaborative cross-national survey. From: <http://www.hbsc.org/publications/journal/>, Accessed date: 24 July 2018.
- Johnston, L.D., Miech, R.A., O'Malley, P.M., Bachman, J.G., Schulenberg, J.E., Patrick, M.E., 2018. Monitoring the Future National Survey Results on Drug Use: 1975–2017: Overview, Key Findings on Adolescent Drug Use. Institute for Social Research, The University of Michigan, Ann Arbor From: <http://monitoringthefuture.org/pubs/monographs/mtf-overview2017.pdf>, Accessed date: 28 August 2018.
- Kraus, L., Seitz, N.-N., Piontek, D., Molinaro, S., Siciliano, V., Guttormsson, U., Arpa, S., Monshouwer, K., Leifman, H., Vicente, J., Griffiths, P., Clancy, L., Feijão, F., Florescu, S., Labrecht, P., Nociar, A., Raitasalo, K., Spilka, S., Vyshinskiy, K., Hibell, B., 2018. ‘Are the times A-changin’? Trends in adolescent substance use in Europe. *Addiction* 113, 1317–1332. <https://doi.org/10.1111/add.14201>.
- Leos-Toro, C., Reid, J.L., Madill, C.L., Rynard, V.L., Manske, S.R., Hammond, D., 2017. Cannabis in Canada - Tobacco Use in Canada: Patterns and Trends, 2017 Edition, Special Supplement. Propel Centre for Population Health Impact, University of Waterloo, Waterloo, ON. From: https://uwaterloo.ca/tobacco-use-canada/sites/ca.tobacco-use-canada/files/uploads/files/cannabissupplement_2017_final_accessible.pdf, Accessed date: 5 January 2018.
- Macdonald, R., Rotermann, M., 2018. Constructing Historical Cannabis Consumption Volume Estimates for Canada, 1960 to 2015: chart 2 – estimated prevalence of cannabis consumption in Canada, persons aged 18 to 24. Feb 21. From: <https://www150.statcan.gc.ca/n1/pub/11-633-x/11-633-x2018015-eng.htm>, Accessed date: 19 July 2018.
- Mahamad, S., Hammond, D., 2018. Retail price and availability of illicit cannabis in Canada. *Int. J. Drug Policy* (in press).
- Mauro, P.M., Carliner, H., Brown, Q.L., Hasin, D.S., Shmulewitz, D., Rahim-Juwel, R., Sarvet, A.L., Wall, M.M., Martins, S.S., 2018. Age differences in daily and nondaily cannabis use in the United States, 2002–2014. *J. Stud. Alcohol Drugs* 79 (3), 423–431.
- McKiernan, A., Fleming, K., 2017. Canadian Youth Perceptions on Cannabis. Canadian

- Centre on Substance Abuse, Ottawa, Ont. From: <http://www.ccsa.ca/Resource%20Library/CCSA-Canadian-Youth-Perceptions-on-Cannabis-Report-2017-en.pdf>, Accessed date: 3 February 2017.
- National Academies of Sciences, Engineering, and Medicine, 2017. The Health Effects of Cannabis and Cannabinoids: Current State of Evidence and Recommendations for Research. The National Academies Press, Washington, DC From: <https://www.nap.edu/read/24625/chapter/1>, Accessed date: 5 January 2018.
- Patrick, M.E., Schulenberg, J.E., O'Malley, P.M., Maggs, J.L., Kloska, D.D., Johnston, L.D., Bachman, J.G., 2011. Age-related changes in reasons for using alcohol and marijuana from ages 18 to 30 in a national sample. *Psychol. Addict. Behav.* 25, 330–339. <https://doi.org/10.1037/a0022445>.
- Pope, H.G., Gruber, A.J., Hudson, J.I., Cohane, G., Huestis, M.A., Yurgelun-Todd, D., 2003. Early-onset cannabis use and cognitive deficits: what is the nature of the association? *Drug Alcohol Depend.* 69 (3), 303–310. [https://doi.org/10.1016/S0376-8716\(02\)00334-4](https://doi.org/10.1016/S0376-8716(02)00334-4).
- Porath-Waller, A.J., Brown, J.E., Frigon, A.P., Clark, H., 2013. What Canadian Youth Think About Cannabis. Canadian Centre on Substance Abuse, Ottawa, ON From: <http://www.ccsa.ca/Resource%20Library/CCSA-What-Canadian-Youth-Think-about-Cannabis-2013-en.pdf>, Accessed date: 20 December 2016.
- Richmond-Rakerd, L.S., Slutske, W.S., Deutsch, A.R., Lynskey, M.T., et al., 2015. Progression in substance use initiation: a multilevel discordant monozygotic twin design. *J. Abnorm. Psychol.* 124 (3), 596–605. <https://doi.org/10.1037/abn0000068>.
- Rotermann, M., Macdonald, R., 2018. Analysis of trends in the prevalence of cannabis use in Canada, 1985 to 2015. *Health Rep.* 29 (2), 10–20. <https://www150.statcan.gc.ca/n1/en/pub/82-003-x/2018002/article/54908-eng.pdf?st=FpFTbc7F>, Accessed date: 9 July 2018 (Statistics Canada Catalogue no. 82-003-X).
- Rynard, V., Cumming, T., Burkhalter, R., Manske, S., 2014/2015. Canadian Student, Tobacco, Alcohol and Drugs Survey Microdata User Guide. Propel Centre for Population Health Impact, University of Waterloo, Waterloo, Ontario, pp. 1–47 (2015).
- SAS Institute Inc., 2018. SAS/STAT 14.3 User's Guide: The GLM Procedure. From: http://documentation.sas.com/?docsetId=statug&docsetTarget=statug_glm_details29.htm&docsetVersion=14.3&locale=en, Accessed date: 18 July 2018.
- Schauer, G.L., Peters, E.N., 2018. Correlates and trends in youth co-use of marijuana and tobacco in the United States, 2005–2014. *Drug Alcohol Depend.* 185, 238–244. <https://doi.org/10.1016/j.drugalcdep.2017.12.007>.
- Shrier, L.A., Scherer, E.B., 2014. It depends on when you ask: motives for using marijuana assessed before versus after a marijuana use event. *Addict. Behav.* 39, 1759–1765. <https://doi.org/10.1016/j.addbeh.2014.07.018>.
- Silins, E., Horwood, L.J., Patton, G.C., et al., 2014. Young adult sequelae of adolescent cannabis use: an integrative analysis. *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).
- Statistics Canada Health reports: prevalence and correlates of non-medical only and self-defined medical and non-medical cannabis use. From: <https://www150.statcan.gc.ca/n1/en/daily-quotidien/180718/dq180718b-eng.pdf?st=P7sSlGnz>, Accessed date: 19 July 2018.
- ter Bogt, T., Schmid, H., Nic Gabhainn, S., Fotiou, A., Vollebergh, W., 2006. Economic and cultural correlates of cannabis use among mid-adolescents in 31 countries. *Addiction* 101, 241–251. <https://doi.org/10.1111/j.1360-0443.2006.01309.x>.
- Toumbourou, J.W., Rowland, B., Ghayour-Minaie, M., Sherker, S., Patton, G.C., Williams, J.W., 2018. Student survey trends in reported alcohol use and influencing factors in Australia. *Addiction* 37 (S1), S58–S66. <https://doi.org/10.1111/dar.12645>.
- UNICEF Office of Research, 2013. Child well-being in rich countries – a comparative overview. In: Innocenti Report Card 11. UNICEF Office of Research, Florence 978-88-6522-016-0, From: https://www.unicef-irc.org/publications/pdf/rc11_eng.pdf, Accessed date: 20 December 2016.
- United Nations Office on Drug and Crime, 2016. World drug report. From: http://www.unodc.org/doc/wdr2016/WORLD_DRUG_REPORT_2016_web.pdf, Accessed date: 20 December 2016.
- Wall, M.M., Mauro, C., Hasin, D.S., et al., 2016. Prevalence of marijuana use does not differentially increase among youth after states pass medical marijuana laws: commentary on and reanalysis of US National Survey on Drug Use in Households data 2002–2011. *Int. J. Drug Policy* 29, 9–13. <https://doi.org/10.1016/j.drugpo.2016.01.015>.
- Warren, J.C., Smalley, K.B., Barefoot, K.N., 2015. Perceived ease of access to alcohol, tobacco, and other substances in rural and urban US students. *Rural Remote Health* 15 (4), 3397.
- Williams, J., Bretteville-Jensen, A.L., 2014. Does liberalizing cannabis laws increase cannabis use? *J. Health Econ.* 36, 20–32. <https://doi.org/10.1016/j.jhealeco.2014.03.006>.