

<b>Article details: 2019-0229</b>	
Title	Trends and correlates of cannabis use in Canada: a repeated cross-sectional analysis of national surveys from 2004 to 2017
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<b>Reviewer 1</b>	Dr. Tea Rosic
Institution	Department of Psychiatry and Behavioural Neurosciences, McMaster University, Hamilton, Ont.
General comments (author response in bold)	<p>The authors have conducted an interesting and highly topical study, leveraging nationally-collected cross-sectional data. This study is important and timely, considering the need to understand trends and patterns of cannabis use pre-legalization of recreational cannabis in order to situate the information we will obtain post-legalization. The authors were able to tease out age groups 15-19 and 20-14 which provides new and helpful information on the use of cannabis in the young adult population – a population for which cannabis use is particularly concerning. The analyses appear to be sound and the manuscript is well written overall.</p> <p><b>We thank the reviewer for these comments and address the points below.</b></p> <p>There are several additional things I believe the authors should consider:</p> <ol style="list-style-type: none"> <li>1. In the Abstract, I would suggest saying “Cannabis was the most widely used illicit drug”, to account for the fact that alcohol use surpasses cannabis use. <b>The sentence has been revised to reflect the reviewer’s comment (page 2).</b></li> <li>2. In the introduction, page 6, line 15, the authors write that “...consumption has occurred within only two years following legalization.” What is the timeframe of the NCS survey? Since legalization occurred in October 2018, two years has not yet passed, therefore this sentence is confusing. <b>This is now revised. The data is from March 2018 to December 2019. The sentence in the introduction has been revised to reflect “less than” two years, rather than two years exactly (page 3). We present some data from the NCS to illustrate a more recent estimate of cannabis prevalence. The NCS used a different sampling method compared to the other surveys we present and may not be directly comparable to our findings.</b></li> <li>3. How do the trends in increasing cannabis use align with the proposal and process of legalization of recreational cannabis undertaken by the Canadian government? (i.e., when did this process start and does it follow the beginning of increases in cannabis use). Similarly, how does the increase in cannabis use align with the legalization of medical cannabis? <b>The legislation to legalize recreational cannabis use was published in 2017. The increase in prevalence of cannabis consumption from 2011 to 2017 demonstrate a possible increase in social acceptability and behavior change that align with the government’s decision to decriminalize the use of recreational cannabis. As stated previously, the data from the National Cannabis Survey (NCS) between March 2018 and December 2019 indicate a further increase in national (excluding the territories) cannabis consumption.</b></li> <li>4. It might be worth highlighting in the discussion the finding of low, but substantially increasing use of cannabis in the elderly population (65+) for whom risks of cannabis are unknown and very much under-studied. <b>The increasing use of cannabis in the elderly population is of particular</b></li> </ol>

	<p><b>concern and has been highlighted in the Discussion (page 12).</b></p> <p>5. On page 15, the authors write "...assess the influence of the new legislature...". I believe the more appropriate term would be "legislation", not "legislature".  <b>The sentence has been revised to reflect the reviewer's comment (page 12).</b></p> <p>6. Is it possible that increases in self-reported cannabis use reflect decreased stigma in reporting use, rather than true increases in use? This should be considered in the Limitations section.  <b>Increases in prevalence may be a combination of increasing use and decreased social stigma associated with cannabis use related to a willingness for respondents to report cannabis use. We include this point in the discussion, page 13.</b></p>
<b>Reviewer 2</b>	Dr. Greg Carney
Institution	Therapeutics Initiative, University of British Columbia, Vancouver, BC
General comments (author response in bold)	<p>Overall, this is a well written and methodologically sound manuscript. The primary finding of an increasing trend in cannabis use pre-legalization lacks novelty and has been reported elsewhere. However, there are some interesting findings in the sub-population analyses that substantively contributes to the body of knowledge.  <b>We thank the reviewer for this positive critique of the manuscript. We agree that the overall findings have been presented; we now emphasize the new findings of cannabis use trends across subgroups of interest. We have revised the introduction and discussion to reflect this, and this is further described in our responses below.</b></p> <p>1. The key issue with this study is lack of novelty in the primary finding. Canadian cannabis consumption trends have been extensively reported elsewhere. These studies have reported similar findings and should be referenced:</p> <ul style="list-style-type: none"> <li>a. Rotermann M, Macdonald R. Analysis of trends in the prevalence of cannabis use in Canada, 1985 to 2015. Health Rep. 2018 Feb 21;29(2):10-20.</li> <li>b. Rotermann M. Analysis of trends in the prevalence of cannabis use and related metrics in Canada. Health Rep. 2019 Jun 19;30(6):3-13. doi: 10.25318/82-003-x201900600001-eng.</li> <li>c. Sikorski C, Letherdale S, Cooke M. Original quantitative research Tobacco, alcohol and marijuana use among Indigenous youth attending off-reserve schools in Canada: cross-sectional results from the Canadian Student Tobacco, Alcohol and Drugs Survey. Health Promot Chronic Dis Prev Can. 2019 Jun; 39(6-7): 207–215.</li> <li>d. Leos-Toro C, et al. Trends in cannabis use over time among Canadian youth: 2004-2014. Prev Med. 2019 Jan;118:30-37. doi: 10.1016/j.ypmed.2018.10.002. Epub 2018 Oct 11.</li> </ul> <p>The authors should consider referencing the above studies in the 2nd paragraph of the discussion (page 10) and address relevant findings.  <b>We thank the reviewer for these additional citations. These are included in our revised manuscript (pages 10-11). We emphasize the extensions of our study which: 1) combine individual data across surveys to do pooled and comparable analyses; 2) analyze cannabis consumption separately for age, education and pregnancy with consistent methodologies; and 3) consider geographic variation by province.</b></p> <p>Specific Issues:</p>

	<p>2. Typo on Page 7 “Trends in Cannabis Consumption 2004-2107”. <b>The typographical error has been corrected (page 7).</b></p> <p>3. Were the surveys available to respondents in languages other than English? <b>All surveys were offered in English or French, this is included on page 5.</b></p> <p>4. Discuss limitations with random digit dialing telephone interviews, particularly non-response bias, and how that could impact the generalizability of the sample of included participants being nationally representative <b>Statistics Canada uses a Random digit dialing methodology for many of its surveys (e.g., the General Social Survey, Canadian Labour Force Survey) in addition to the CTUMS, and the CTADS. This is an efficient design and, in general, performs well, although there are some limitations and some potential biases in terms of population coverage. For instance, households and individuals without a landline telephone (and those with only mobile phones) are excluded. In 2010, it was estimated that about 15% of the population do not have a landline, and this figure is likely increasing. This may also produce other biases related to the socioeconomic status of phone ownership, which may correlate with cannabis consumption. The survey data are weighted to account for individuals without landlines, although this may not entirely remove the biases. We have added this discussion to our limitations (page 14).</b></p> <p>5. You found a 45% increase in 12-month Cannabis Consumption (all-ages) between 2012 and 2017. This represents a dramatic increase in the cannabis market, and warrants further discussion on the likelihood of this being a true increase versus an issue with the validity of the survey results. If this is a true effect, the authors could spend more time discussing what may have led to this: Did beliefs and attitudes towards cannabis shift with the prospect of legalization on the horizon? Has the use of vaping led to an expansion of the cannabis market? Have guidelines for medical use changed? <b>We agree that this is a substantial increase. We have provided some additional discussion and context around this finding. At the time, we feel that the growth is related to true increases as well as increasing social acceptability of cannabis use in Canada, which may increase disclosure of use by survey respondents. Similar findings have been reported in some of the US research following legalization.</b></p>
<b>Reviewer 3</b>	Dr. Mon Hnin Tun
Institution	Department of Pediatrics, University of Alberta, Edmonton, Alta.
General comments (author response in bold)	<p>This manuscript aims to describe the trends in cannabis use among Canadians using 12 nationally representative surveys.</p> <p>1. The authors reported using CTUMS from 2004-2012 and also reported CTUMS is conducted by Statistic Canada on annual basis. Why the author did not include CTUMS 2013-2017? <b>CTUMS was amalgamated with CADUMS to form CTADS and the CTUMS was discontinued after 2012. Revisions have been made to the manuscript to add details on the three surveys (page 4).</b></p> <p>2. It was not clear whether the author combine CTUMS and CTADS for the analysis and analyze CADUMS separately for the cannabis consumption in</p>

pregnancy? Is there any cannabis usage for medical reason?

**The CTUMS, CTADS, and CADUMS data were combined for analyses. We used CADUMS separately to examine the use of cannabis in pregnancy and compared it to a reference group of 15-44-year-old women from all surveys. The CADUMS was the only survey identified which asked questions regarding both histories of pregnancy and cannabis use within the past year. Regarding medical use, we determined through an analysis of the CTADS in 2015 and 2017 that the majority of reported cannabis use was recreational (about 65-70%). We have included this information in the revised manuscript (pages 13-14).**

3. CTADS captures tobacco, alcohol and drugs usage. Did the author look at the association between tobacco, alcohol or drugs usage with cannabis utilization?

**The Use of cigarettes correlated with cannabis use, and these data were available in all surveys. We now include tobacco use in all analyses, as suggested. Alcohol use was not consistently available in the surveys, and we have not included it.**

4. The study reported trends as the weighted prevalence with a 95% confidence interval. However, it was not mentioned what kind of trend test was utilized in the method section.

**We use a linear test of trend. We have now revised the modelling strategy to use a segmented regression model as suggested; see page 6 in the revised manuscript.**

5. Did the authors combine CTUMS and CTADS to get the full dataset? If so, how did the authors take the overlap between the groups into consideration?

**CTUMS was used for all analyses (excluding pregnancy-related analyses) between the years 2004-2012, and CTADS was used for all analyses for the years 2013, 2015 and 2017, which did not overlap with CADUMS. The only possible overlap in data would be between CTUMS and CADUMS within the years 2008-2012. To address this overlap, we include a term for survey type in all analyses in addition to the year of the survey. [To the editor: it was not clear what overlap was referring to, we have taken this to mean overlap in the sampling between surveys]**

6. The authors did not mention about missing data in the survey dataset.

**We have added details of the missing data (beginning on page 6). The amount of missing data was low, and no single item exceeded 2% missing. We did not perform any missing data imputation.**

7. The authors reported using logistic regression model to the full dataset with covariates for survey year, age, sex, age, education and region. The authors also did the stratified analysis and reported geographical variation in the cannabis usage. The authors should consider conducting multilevel modeling taken into geographical variation.

**We considered multilevel modelling as an alternative parametrization of the model, using province as a random effect. These models were not substantively different in terms of the main effect of the trend over time. However, in this context, our interest was in the fixed portion of the model and disaggregated trends by subgroups. We decided to use logistic regression with a fixed effect for the province instead of multilevel modelling**

**for this analysis.**

8. The trends reported in Figure 1 should be age and sex standardized. Likewise for the other trend results.

**We replace figure 1 with a new figure that shows male and female trends, and these are age-standardized prevalence. The other trends are disaggregated by age and sex (new Figure 2), or age-adjusted (Figures 1,3,4).**

9. Did the authors make any assumption made for the prevalence of Cannabis use in relation to the employment and education level?

**We hypothesize a social gradient consistent with findings in tobacco and used education as a marker or socioeconomic status.**

10. A table or figure for the results of cannabis consumption and pregnancy would be beneficial.

**This is now included (table 2).**

11. Similar for the findings of the association between education level and cannabis utilization.

**This is included (Figure 4, Table 3).**

12. Did Figure 3 & 4 represent results from the combination of CTUMS and CTADS? If so, please mention.

**All figures are from the CTUMS, CTADS, and CADUMS. We have added notes to the figures to clarify the data sources.**

13. It would be helpful to conduct sensitivity analysis using different definition of cannabis usage or replacing the past year cannabis use with past month use.

**We examine past year and past 3-month cannabis use in the CTADS (years 2013,2015,2017), and present these analyses in the results (Supplemental Table S2). Past month cannabis use was not available in the CTUMS or CADUMS, we discuss this limitation (page14).**

The authors reported the limitation of availability of socioeconomic status in the trend analysis of cannabis use in Canada.

**Socioeconomic status data were limited, although education was available as a marker of socioeconomic status, and we have included these analyses. Education was not available in the CTADS 2013 and 2015. We note this limitation on page 14.**