Impact of Cannabis Legalization on Hospitalizations in Alberta: Interrupted Time Series Analysis by Age and Sex

Chunghah Kim
York University

Yihong Bai
York University

Sara Allin
University of Toronto

Maritt Kirst
University of Toronto

Patricia O'Campo
University of Toronto

Kristine Ienciu
York University

Xiaoyang Xia
York University

Frank MacMaster
University of Calgary

Katherine Rittenbach
University of Alberta

Antony Chum (chuma@yorku.ca)
York University

Short Report

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Abstract

Using population-wide health administrative data in Alberta, Canada (10/2015-05/2021, n = 3,493,864), we find that cannabis legalisation was not associated with significant increases in cannabis-related hospitalizations. Hospitalization rates were higher in young adults (18–24) compared to those 25+, and the introduction of edibles was associated with insignificant immediate increases of 23% and 18% among younger women and men respectively. Comparison with patterns in Ontario from a prior study finds that cannabis legalisation led to increased hospitalization in Ontario but not Alberta. The findings highlight the need for targeted screening and interventions for young adults.

Introduction

Canada implemented recreational cannabis legalization in two phases: phase 1 legalized flowers and herbs with limited retail access (Oct 2018-Mar 2020), while phase 2 allowed edibles, extracts, and topicals with more retail availability (Mar 2020-May 2021). Given that legalization increases cannabis consumption[1], which increases the likelihood of cannabis-related acute events, studies explored the impacts of legalization on cannabis-related emergency department visits in Canada[2–5]. However, relatively few investigations of cannabis-related hospitalizations exist, but is warranted as they signify severe cases that necessitate in-patient care and result in significant healthcare costs.

An Ontario study (based on the same 2-phase model) found phase 1 had increased hospitalizations for young (18–24) and older adults (25+), while phase 2 showed no significant increases [6]. Research on Quebec's youth (under 20) found a sharp increase in cannabis-related hospitalizations post-initial legalization among boys under 15 [7]. Another paediatric study on children 0–9 years found that cannabis-related hospitalizations and poisonings increased in Canadian jurisdictions where cannabis edibles were sold, compared to the province that prohibited edibles[8]. Given the unique factors shaping Alberta's cannabis sales landscape among Canadian provinces (e.g., lowest minimum age of purchase at 18 and highest number of physical stores per capita[9]), legalization phases 1&2 might have led to increases in cannabis-related hospitalizations.

Methods

The study cohort (n = 3,493,864) includes adults aged 18 + in Alberta eligible for provincial universal healthcare (October 2015-May 2021). The age classifications were determined based on each participant's age on the date of cannabis legalization in Canada. During the study period, cannabis-related hospitalizations were tracked using codes F12 and T40.7 from the ICD-10-CA (International Classification of Disease, version 10-Canada), similar to a previous study on cannabis-related hospitalization[6]. These hospitalizations were identified through the Discharge Abstract Database. Using both primary and non-primary diagnoses, positive cases were determined, using the same ICD-10-CA codes found in prior studies (Appendix Table S1). The data was segmented into three periods: pre-legalization, phase 1, and phase 2. Using negative binomial segmented regressions, the study estimated
the incidence rate ratios (IRRs) for immediate changes and trends during these periods. The analysis also considered the effects of age and sex on hospitalization rates. Thus, we divided the sample into four demographic groups: younger women and men (aged 18–24) and older women and men (24+). To account for the early effects of the COVID-19 pandemic, an indicator for March and April 2020 was included in the analysis, in line with methodologies from previous research[2, 4]. The study received ethical approval through York University (REB 20-134-CHUM).

Results

<insert Table 1 here>

Table 1. Cannabis-related Hospitalization Rates per 100,000 Population, and Association Between Phases of Legalization and Cannabis-Related Hospitalization (Estimated from Negative Binomial Segmented Regression) with IRRs by age and sex)

The most prevalent cannabis-related diagnoses leading to hospitalizations were harmful use (F12.1) and dependence syndrome (F12.2), accounting for 41% and 39% of cases, respectively. From Table 1, hospitalization rates per 100,000 population indicated that adults aged 18–24 experienced higher rates compared to those aged 25 and above across all study phases. Supplemental Figure 1 shows the changes in cannabis-related hospitalization rates over time across the 4 groups. Regression models estimated that before cannabis legalization, there were significant month-to-month increases in hospitalization rates for women aged 18–24 at 0.85% per month (95% CI: 0.08%, 1.62%) and men aged 18–24 at 1.57% per month (95% CI: 0.91%, 2.24%). Conversely, the IRR for adults aged 25 and above trended downwards in the same period (-0.11% monthly for women and -0.18% for men). The first phase of legalization was not significantly linked to immediate or ongoing changes in hospitalization rates, except a 2.4% (95% CI: -0.54%,-4.43%) month-to-month decrease for men aged 18-24. The second phase of legalization was accompanied by non-significant immediate increases in adults 18-24, with 22.70% increase (95%: -25.01 – 70.42) in younger women and 17.87% (95% CI: -21.11 – 56.85) in younger men, while month-to-month trends in this period was flat for all groups.

Discussion

Higher rates of cannabis-related hospitalizations were observed in young adults (compared to those 25+) in Alberta, and the legalization of cannabis edibles (phase 2) was associated with an insignificant immediate increase of 23% and 18% additional hospitalizations among younger women and men respectively. In the context of a study that contains all individuals in the provincial universal healthcare system, the observed estimates would likely reflect broader population trends, but the fluctuating month-to-month hospitalization rates suggests variability and inconsistent patterns in the data. These findings call for targeted screening and intervention programs for young adults. Compared to prior research examining cannabis-related hospitalizations in Ontario[6], which found men 25+ showing month-to-month increases in hospitalization rates pre-legalization, as well as immediate and trend increases in
men and women 25+ in phase 1, Alberta saw no significant change in rates over the entire study period in the same groups. For younger adults (18–24), unlike the Ontario study, which reported month-to-month decreases before legalization, Alberta observed month-to-month increases before legalization for both sexes, which is unexpected. During phase 1 in Ontario, immediate and trend increases for younger adults of both sexes were observed; on the other hand, in Alberta, a decreasing trend among younger men in phase 1 was observed (-2.4% per month, CI -4.43,-0.54). In phase 2, both provinces did not witness any significant changes for all populations (only insignificant immediate increases were observed in Alberta).

Therefore, based on this study and the previous Ontario study, while phase 1 legalization was associated with more deleterious changes in Ontario than in Alberta, phase 2 was not associated with significant changes in either province.

Cannabis price shifts over phase 1 may have affected these differences. Alberta saw a higher increase in cannabis prices (24%), compared to 8.5% in Ontario[9], which may have reduced the demand and subsequent adverse effects (e.g., hospitalization among the young adult male population). Although Canada legalized recreational cannabis in 2018 at the national level, the effects on cannabis-related hospitalizations seem to vary across provinces due to diverse contexts. Policymakers should consider these provincial variations, especially the influence of factors like price shifts when developing or refining cannabis-related policies. Our findings suggest that younger adults, especially those aged 18–24, experienced higher rates of cannabis-related hospitalizations (i.e., 3.5 times higher in younger men, and 4.6 times higher in younger women, compared with their aged 25+ counterparts). Clinicians should be aware of this increased risk in younger groups and may benefit from early identification and intervention strategies, including screening and brief interventions in primary care settings.

Limitations of this study include 1) challenges isolating the effects of introducing edibles from COVID-19. 2) Using primary and secondary diagnoses to identify the outcomes may introduce bias. 3) Lack of a control group to establish a causal relationship. 4) This study was limited to examining the pre vs post-legalization periods, but further analyses using sales data from legal and illegal markets may provide more insight into the relationship between cannabis availability and potential acute care harms. The strengths of this study include that: 1) the study cohort includes the population in Alberta eligible for universal healthcare; 2) it is the first study examining the effect of cannabis legalization on cannabis-related hospitalizations by age and sex in Alberta, which allows for a nuanced understanding of how these sub-groups are affected, leading to more tailored analyses; 3) the impact of legalization may have been affected by the existing black market, but we have not considered it in our model. Given that approximately 4% of Canadians obtain cannabis from the black market[10], there may be a complex interplay between cannabis legalization, black market prices/availability, and subsequent impact that needs to be further investigated.

Declarations

Data availability statement
The data used is held by Alberta Health Services. While data sharing agreements prohibit us from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access from Alberta Health Services. The dataset creation plan and underlying analytics code are available from the authors upon request.

Funding

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Ethics approval

Ethics approval for this study was obtained through York University (REB# 2022-254). Patient consent for publication not applicable. Permission to reproduce material from other sources not applicable as no materials were reproduced from other sources.

Author Contribution

CK, YB, and AC co-wrote the first draft of the study. CK, AC, and KR analyzed the data. CK, YB, and AC contributed to the interpretation of the data. AC and CK co-wrote the dataset creation plan. AC conceived of the initial project and provided funding and oversight of the study. All of the authors revised it critically for important intellectual content, gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

Conflicts of interest: None

Statement of adherence to preprint policy (if a manuscript was posted on a preprint server, then state the preprint server used, the DOI, and a URL for the preprint; see Preprint Policy in "Originality and Validity" section above): None

References


Tables
# Table 1
Cannabis-related Hospitalization Rates per 100,000 Population, and Association Between Phases of Legalization and Cannabis-Related Hospitalization (Estimated from Negative Binomial Segmented Regression) with Estimated Incidence Rate Ratios by age groups and sex

<table>
<thead>
<tr>
<th></th>
<th>Women 18–24 (n = 175,983)</th>
<th>Men 18–24 (n = 183,835)</th>
<th>Women ≥ 25 (n = 1,561,993)</th>
<th>Men ≥ 25 (n = 1,572,053)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cannabis hospitalizations monthly proportion per 100,000 (SD)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-legalization (18 Oct 2015–17 Oct 2018)</td>
<td>16.73 (3.68)</td>
<td>22.58 (5.42)</td>
<td>3.63 (0.53)</td>
<td>6.54 (0.75)</td>
</tr>
<tr>
<td>Phase 1 (18 Oct 2018–17 Mar 2020)</td>
<td>18.11 (4.39)</td>
<td>28.31 (4.64)</td>
<td>3.86 (0.56)</td>
<td>7.01 (0.69)</td>
</tr>
<tr>
<td>Phase 2 (18 Mar 2020–17 May 2021)</td>
<td>21.67 (4.65)</td>
<td>31.29 (5.48)</td>
<td>4.13 (0.56)</td>
<td>7.37 (0.75)</td>
</tr>
</tbody>
</table>

**Association between phases of cannabis legalization and cannabis-related hospitalization: change (95% CI) (P-value)**

(4 models: women 18–24, men 18–24, women ≥ 25, men ≥ 25)

<table>
<thead>
<tr>
<th></th>
<th>Women 18–24 (n = 175,983)</th>
<th>Men 18–24 (n = 183,835)</th>
<th>Women ≥ 25 (n = 1,561,993)</th>
<th>Men ≥ 25 (n = 1,572,053)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-legalization Trend</td>
<td>0.85% (95% CI: 0.08–1.62)</td>
<td>1.57% (95% CI: 0.91–2.24)</td>
<td>−0.11% (95% CI: -1.76–1.54)</td>
<td>-0.18% (95% CI: -1.41–1.05)</td>
</tr>
<tr>
<td>(P-value = 0.03)</td>
<td>(P-value = 0.01)</td>
<td>(P-value = 0.89)</td>
<td>(P-value = 0.79)</td>
<td></td>
</tr>
<tr>
<td>Phase 1 immediate change</td>
<td>-4.22% (95% CI: -31.92–23.48)</td>
<td>4.47% (95% CI: -17.76–26.72)</td>
<td>7.18% (95% CI: -53.68–68.05)</td>
<td>8.42% (95% CI: -36.92–53.77)</td>
</tr>
<tr>
<td>(P-value = 0.76)</td>
<td>(P-value = 0.69)</td>
<td>(P-value = 0.81)</td>
<td>(P-value = 0.71)</td>
<td></td>
</tr>
<tr>
<td>Phase 1 Trend</td>
<td>-1.10% (95% CI: -3.51–1.30)</td>
<td>-2.4% (95% CI: -4.43–0.54)</td>
<td>0.20% (95% CI: -5.00–5.40)</td>
<td>0.36% (95% CI: -3.51–4.22)</td>
</tr>
<tr>
<td>(P-value = 0.37)</td>
<td>(P-value = 0.01)</td>
<td>(P-value = 0.94)</td>
<td>(P-value = 0.85)</td>
<td></td>
</tr>
<tr>
<td>Phase 2 immediate change</td>
<td>22.70% (95% CI: -25.01–70.42)</td>
<td>17.87% (95% CI: -21.11–56.85)</td>
<td>7.10% (95% CI: -98.84–113.03)</td>
<td>10.25% (95% CI: -68.42–88.93)</td>
</tr>
<tr>
<td>(P-value = 0.35)</td>
<td>(P-value = 0.37)</td>
<td>(P-value = 0.89)</td>
<td>(P-value = 0.79)</td>
<td></td>
</tr>
<tr>
<td>Phase 2 Trend</td>
<td>-0.68% (95% CI: -4.28–2.93)</td>
<td>1.40% (95% CI: -1.56–4.35)</td>
<td>0.07% (95% CI: -7.38–8.78)</td>
<td>0.08% (95% CI: -5.95–6.10)</td>
</tr>
<tr>
<td>(P-value = 0.71)</td>
<td>(P-value = 0.35)</td>
<td>(P-value = 0.86)</td>
<td>(P-value = 0.98)</td>
<td></td>
</tr>
</tbody>
</table>
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