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# Trends in location of physical cannabis retail stores across Canada one month following legalization

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**Background**
How provinces and territories regulate the location of cannabis stores is a key consideration when implementing cannabis legalization. We examined factors associated with access to cannabis stores across Canada following legalization.

**Methods**
On November 17, 2018 we extracted the address and operating hours of every legal cannabis store in Canada from online government and private listings. We conducted a cross-sectional analysis examining measures of cannabis access including: outlet density; median distance to the nearest school; and relative availability of cannabis in low-income neighbourhoods. We compared these measures between province and territories (jurisdictions) with private- and government-run stores.

**Results**
One month after legalization, there were 159 cannabis stores across Canada, with stores in every jurisdiction except Ontario and Nunavut. In jurisdictions with a private retail model compared to government model, there were 2.8 times the number of stores per capita, stores were open on average 17.9 more hours per week and stores were located closer to schools (median 169 meters). In both retail models, there was 2.3 times more access to stores for neighborhoods in the lowest income quintile compared to the highest income quintile.

**Conclusions**
Jurisdictions with privately-run cannabis retail have greater access to cannabis and closer proximity to schools. In all jurisdiction cannabis access is greater in low income neighborhoods. These trends – based on experience from tobacco and alcohol research – may result in disproportionate cannabis-related health harms in vulnerable populations. Ongoing work is needed to determine the association between cannabis access and health-related harms, as well as the relative impact of online cannabis sales.

## INTRODUCTION

On October 17, 2018 Bill C-45, *The Cannabis Act,* came into effect allowing adults across Canada to purchase recreational cannabis legally.(1) The legislation has two stated main purposes: eliminating the illicit cannabis market and preventing youth from accessing cannabis.(2) Cannabis use is not benign and is associated with negative health outcomes including mental health problems such as psychosis and addiction,(3–6) cannabis-related motor vehicle collisions,(7) and poisonings, particularly unintentional ones among children.(8) Canada is the first high-income country to legalize the sale of recreation cannabis, and there is limited evidence to guide policies aimed at minimizing cannabis-related harms. Principles to mitigate harms, however, can be drawn from decades of alcohol and tobacco control policy, which suggest three of the most effective measures to decrease harmful substance use are regulating marketing and advertising, controlling the price of substances, and controlling the physical availability of sales.(9,10) This study examined the physical availability of cannabis sales in Canada.

Meeting the dual goals of legalizations will require balancing tight regulations on youth access to cannabis to minimize potential health harms while ensuring appropriate access to legal and regulated cannabis to eliminate the illicit market. While general principals governing the sale of cannabis are laid out in Bill C-45, the majority of regulations around retail fall to decisions by individual territories and provinces. As such, Canada is in the midst of a cannabis experiment, both nationally and at the provincial and territorial level. Although there are differences between each jurisdiction's decision to regulate the sale of cannabis, one helpful comparison is whether the region has adopted a privately-run or a government-run cannabis retail system. This decision is an important policy option available to governments when controlling overall access and placement of cannabis stores. Evidence from the alcohol literature suggests that government-run retail systems generally have lower access to alcohol sales and lowest levels of alcohol consumption.(11,12)

To help guide policy makers and further the discourse on regulating cannabis sales in Canada, we examined measures of access to the physical cannabis retail market one month following legislation and their association to key neighbourhood characteristics, including proximity to schools and low-income neighbourhoods. We also compared measures of cannabis access between jurisdictions with privately-run and government-run stores.

## METHODS

### Study Design

We conducted a cross-sectional analysis examining measures of access to cannabis retail stores one month following recreational cannabis legalization in Canada. Between October 29, 2018 and November 17, 2018, we collected data on the physical address and operating hours of every legal cannabis outlet through online government and private listings. On November 17, we verified the physical address of every legal cannabis

outlet, through a second online search of the listings. Using GIS software, we calculated measures of access to cannabis stores. We compared measures of cannabis access between jurisdictions with privately-run and government-run stores.

**Study Measures**

Our outcomes of interest included:

i. *Per capita density* of cannabis retail stores, measured by the number of outlets per 100,000 population referend to the 2017 Canadian census population.(13)
ii. *Hours of operation*, measured as the mean total weekly hours of operation for stores.
iii. *Proximity to schools*, measured by the median Euclidean distance from each cannabis outlet to the nearest primary, secondary, or tertiary school. We also calculated the proportion of cannabis outlets located 500 meters to a school.
iv. *Concentration of cannabis outlets in low income neighbourhoods*. We measured this concentration by calculating the relative rate of cannabis outlets per capita between the highest and lowest neighborhood income quintile. Dissemination Area was chosen as the census unit most representative of neighborhoods.

We reported each of these four measures by each province/territory as well as aggregated by privately- or government-run retail model.

**Sources of data**

*Schools.* We used the education layer from the CanMap® content suite published by Desktop Mapping Technologies (DMTI) Inc. to map the location of all elementary schools, secondary schools, colleges, cégeps, and universities in Canada.

*Neighborhoods.* We chose Dissemination Area (DA) as the census unit most representative of neighborhoods. DAs are the smallest geographic unit for which census data is released, and generally contain between 400-700 individuals.(14)

*Neighborhood Income.* We used the variable QAIPPE from the PCCF+ to characterize DAs by neighbourhood income quintile.(15) This variable factors in the size of households and low income cut-offs and incorporates the relative poverty of DAs relative to surrounding DAs within the local Census Metropolitan Area (CMA). The most recent version of the PCCF+ uses data from the 2006 census. We also calculated income quintiles using the median before tax household income for each DA from the 2016 census data for use in a sensitivity analysis

**Data Analysis.**

All data analysis was conducted in STATA Version 15.1 (College Station, TX: StataCorp), and ArcMap 10.5.1 (Redlands, CA: Environmental Systems Research Institute). We used ArcMap to geocode the addresses and postal codes of cannabis stores to a corresponding latitude and longitude. We used ArcMap to calculate the

Euclidean distance between each cannabis store and the nearest school, as well as to calculate the number of cannabis stores located within a 1000-meter Euclidean buffer from the geographic centre of each DA.

We compared the mean weekly hours of operation between privately- and government-run retails using a two-tailed t-test. Given the distance to the nearest school was skewed, we report medians and interquartile ranges. For proximity to schools, we used the Wilcoxon rank-sum test to compare median distance between the private and government models. We used descriptive statistics to examine the mean and variance of the number of cannabis outlets within 1000 meters of the geographic center of neighborhoods. As the mean (0.045) and variance (0.052) showed evidence of overdispersion (poisson goodness of fit test $p < 0.0001$), we fit negative binomial regression models to estimate the association between neighborhood income quintiles and cannabis access. We offset the regressions by the total population of each DA and interpreted our exponentiated beta coefficients as rate ratios per capita. We also adjusted our models based on the population density of each dissemination area. Given the neighbourhood income variable QNIPPE uses data from the 2006 census, we conducted a sensitivity analysis using unadjusted neighbourhood income quintiles from the 2016 census. Statistical significance was set a priori at $p<0.05$.

**Research Ethics**

Given all data was publicly available, no research ethics was required.

**RESULTS**

One month following legalization, there were 159 cannabis outlets operating in Canada: 105 privately-run stores in Newfoundland & Labrador, Manitoba, Saskatchewan, and Alberta and 54 government-run stores in Prince Edward Island, Nova Scotia, New Brunswick, Quebec, British Columbia, Yukon, and North West Territories. Every jurisdiction in Canada except Ontario and Nunavut had an operating physical cannabis store. We were not able to find the hours of operation for two stores in Newfoundland & Labrador, these stores were included in the study but excluded from the weekly hours of operation analysis. An additional, six stores had been granted a license to operate but had not yet opened and were excluded from analysis.

Overall access to cannabis stores was higher in provinces that opted for a private retail model (Table 1). Regions with privately operated cannabis retail had 2.8 times the number of cannabis outlets per capita than regions with government operated cannabis retail (14.5 vs. 5.1 outlets per million population). On average, privately-run outlets were open 17.9 hours per week longer than government-run outlets (mean 80.9 vs. 63.0 hours per week, $p < 0.00001$). Private retail cannabis outlets were located 169 meters closer to a primary, secondary, or tertiary school than government outlets (median distance to nearest school 495 vs. 664 meters, $p = 0.0415$). The proportion of cannabis

retails located within 500 meters of a school was higher in private models than government models (50% vs 38%).



Table 1: Cannabis retail outlets per capita and key neighbourhood characteristics

| Jurisdiction | Population (2017) | Cannabis Outlets | Outlets per 100,000 | Mean (SD) weekly hours of operation | Median distance (IQR) in meters to nearest school |
|---|---|---|---|---|---|
| **PRIVATE CANNABIS RETAIL MODEL** | | | | | |
| Newfoundland & Labrador | 528,817 | 23 | 4.35 | 89.1 (16.1) | 523 (853) |
| Manitoba | 1,338,109 | 11 | 0.82 | 80.9 (3.4) | 535 (1823) |
| Saskatchewan | 1,163,925 | 9 | 0.86 | 59.3 (17.5) | 619 (428) |
| Alberta | 4,286,134 | 62 | 1.45 | 81.2 (7.2) | 466 (456) |
| TOTAL PRIVATE | 7,316,985 | 105 | 1.45 | 80.9 (12.7) | 499 (511) |
| **GOVERNMENT CANNABIS RETAIL MODEL** | | | | | |
| Prince Edward Island | 152,021 | 3 | 1.97 | 83 (0) | 479 (265) |
| Nova Scotia | 953,869 | 12 | 1.26 | 77.3 (0.8) | 823 (504) |
| New Brunswick | 759,655 | 20 | 2.63 | 71 (0) | 976 (843) |
| Quebec | 8,394,034 | 12 | 0.14 | 41.5 (12.9) | 507 (870) |
| Yukon | 38,459 | 1 | 2.60 | 47 (0) | 775 (0) |
| North West Territories | 44,520 | 5 | 11.23 | 40 (17.4) | 501 (172) |
| TOTAL PUBLIC | 10,342,558 | 53 | 0.51 | 63.0 (17.8)* | 664 (558)** |
| **GRAND TOTAL** | 17,659,543 | 158 | 0.94 | 74.8 (16.9) | 531 (617) |

*T-test comparing mean weekly hours of operation between private and government models, p p<0.00001.*
*** Rank sum rest comparing median distance in private and government models, p<0.0415.*
*NB: British Columbia with one public cannabis retail outlet and Ontario and Nunavut each with no physical cannabis outlets were excluded from this analysis.*

There were 28,763 DAs in Canada (not including BC, Nunavut, and Ontario). When we compared the number of cannabis stores located within 1,000 meters from the geographic centre (centroid) of each DA, private retail systems (RR 1.97, 95% CI 1.48-2.48) and government systems (RR 2.78, 95% CI 1.96-3.95) both had more outlets per capita in the lowest compared to the highest neighbourhood income quintile (Table 2). The sensitivity analyses using income quintiles calculated from the 2016 Canadian census did not change the direction of the reported effect sizes, see Appendix A.



Table 2. Negative binomial regression comparing the number of cannabis stores in neighborhoods with the lowest income quintile (Q1) to the highest income quintile (Q5)

| Canadian Jurisdiction[a] | Q1:Q5(reference) Rate Ratio (95%CI) | |
|---|---|---|
| | Model A[c] | Model B |
| **PRIVATE CANNABIS RETAIL MODELS** | | |
| Newfoundland & Labrador | 1.76 (1.02 – 3.04) | 0.95 (0.56-1.61) |
| Manitoba | 6.46 (3.00-13.91) | 3.38 (1.53-7.51) |
| Saskatchewan | [b] | [b] |
| Alberta | 2.48 (1.78-3.26) | 1.93 (1.41-2.65) |
| TOTAL PRIVATE | 2.57 (2.01-3.31) | 1.97 (1.48-2.48) |
| **GOVERNMENT CANNABIS RETAIL MODELS** | | |
| Prince Edward Island | 3.48 (0.72-16.80) | 1.00 (0.16-7.29) |
| Nova Scotia | 3.78 (1.87-7.63) | 3.00 (1.47-6.11) |
| New Brunswick | 2.47 (1.25-4.87) | 1.72 (0.85-3.51) |
| Quebec | 4.15 (2.40-7.18) | 3.04(1.73-5.34) |
| Yukon | [b] | [b] |
| North West Territories | 0.33 (0.03-3.16) | 0.32 (0.03-3.14) |
| TOTAL PUBLIC | 3.26 (2.30-4.60) | 2.78 (1.96-3.95) |

| | | |
|---|---|---|
| **GRAND TOTAL** | 2.75 (2.25-3.36) | 2.27 (1.85-2.80) |

*NB: [a]British Columbia with one public cannabis retail outlet and Ontario and Nunavut each with no physical cannabis outlets were excluded from this analysis. [b]Unstable regression model due to lack of variation in income variable. [c] Both models are offset by the total population of a dissemination area. Model B adjusts for the population density of each DA in persons per square kilometer.*

**INTERPRETATION**

One month following legalization there were 159 cannabis stores operating in every province and territory in Canada except Ontario and Nunavut. Marked discrepancies in access to cannabis stores, including density of outlets and hours of sale, have emerged between provinces. In general, regions that have selected a privately-run model had greater access. In addition, stores in private models were located closer to schools than in government models. Finally, access to stores in both private and government models is concentrating in poor neighbourhoods compared to wealthy neighborhoods.

At present time, there is little evidence regarding the potential health impacts of increased access to cannabis retail in Canada. Decades of tobacco and alcohol research, however, has shown that increased access is associated with increased substance-related use and corresponding health harms.(16–19) The emerging trends of concentration of cannabis retail stores in low income neighborhoods and near schools are worrisome that higher cannabis-related health harms may develop in vulnerable populations, including youth and low socioeconomic status Canadians. This is also consistent with patterns seen in the alcohol and tobacco literature where tobacco and alcohol retail has been found to concentrate near schools and in low income neighborhood(20–22) and to disproportionately impact low socioeconomic status individuals.(23,24)

There are several possible explanations for the findings of increased concentration of cannabis stores in low income neighborhoods including lower levels of rent or property tax, higher anticipated market demand for cannabis in these areas, and commercial zoning bylaws which may exclude stores from higher income neighborhoods. Regardless, policy options are available that if properly implemented could prevent further concentrations of cannabis access and reduce access near poorer neighbourhoods and youth-oriented spaces. To limit concentrations of cannabis access, regions could add limits on the number of stores per capita and require minimum distances between stores. To prevent youth access, regions could enact minimum distances between cannabis stores and schools and other youth facilities. When placing these limits, it is important to consider the parameters of these regulations. For example, current regulation in Ontario will require a minimum separation distance of 150 meters between schools and nearest cannabis stores.(25) As the average individual can walk 150 meters in two minutes, we feel that this current regulation is unlikely to meaningfully reduce youth exposure to cannabis retail.

There is currently a narrow policy window to create healthy public policy around cannabis, particularly in Canada's two largest provinces British Columbia and Ontario where regulations are still being finalized. Jurisdictions must find a reasonable balance between ensuring access to legally produced and regulated cannabis while limiting access to youth and other vulnerable populations. We note experience from the tobacco and alcohol industry has shown that increasing regulations on established industries is challenging.(26,27) We do not anticipate that regulating the cannabis industry will be different. As such, should evidence showing harms from excess cannabis access become stronger, attempts to close or place limits on cannabis retail stores likely will be challenged. The most prudent approach to protecting the public health of Canadian is to begin with stricter controls and await further evidence.

**Limitations**

There are several limitations to this study. First, cannabis retail will continue to develop and trends from these preliminary findings may not accurately represent a more mature cannabis market. Further, our hand search of online listings may have underestimated the number of stores or misrepresented the hours of operation if governments and private retailers delayed updating these listing. Second, we chose one of the simplest measures of access to cannabis when comparing access between low income and high-income neighborhoods. While this measure is easy to explain and communicate it fails to capture important metrics of access such as clustering. Future work should use more sophisticated measures of access including travel time along road networks and spatial access measures.(12,28) Third, we did not account for other neighborhoods characteristics beyond population and population density (e.g. age and sex composition, ethnicity). Fourth, in our analysis of the distance between cannabis stores and the nearest school, the schools are represented as points and the actual boundaries of the school buildings and properties are not considered. As a result, cannabis retail stores are likely closer to schools that reported in this study. Finally, we limited this study to physical cannabis retails, yet all Canadian provincial and territorial governments are allowing online sales. Data around online sales are currently limited, and experts predict the majority of cannabis retail will be through bricks and mortar stores.(29) Further research is needed to understand the relative impact of online cannabis sales and its association with both physical cannabis sales and potential health impacts.

**CONCLUSION**

One month following legalization there is greater access to cannabis in jurisdictions with privately-run cannabis retail system, including closer proximity to schools, compared to government-run retail systems. In addition, cannabis stores are concentrating in low income neighborhoods. Evidence from decades of tobacco and alcohol research suggests that this increased access may result in higher cannabis-related health harms. Further work should investigate whether there is an association

between cannabis access and health-related harms. In the interim, we recommend that policy makers and communities carefully consider whether these emerging trends reflect the desired balance between the dual goals of cannabis legalization – eliminating the illicit cannabis market and preventing youth from accessing cannabis – and make adjustments as necessary.

**Contributor's Statement**

DM, CB, and PT co-conceived and designed the study. DM & CB acquired the data, DM performed the analysis, and DM, CB, and PT interpreted the data. CB & DM co-drafted the article, and PT revised it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to act as guarantors.

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**Appendix A**

Sensitivity analyses using income quintiles from the 2016 Canadian census. Income quintiles were calculated from the median before tax income of economic families.

Table 3. Negative binomial regression comparing the number of cannabis stores in neighborhoods in the lowest income quintile (Q1) to the highest income quintile (Q5)

| Canadian Jurisdiction[a] | Q1:Q5(reference) Rate Ratio (95%CI) | |
|---|---|---|
| | Model A[c] | Model B |
| **PRIVATE CANNABIS RETAIL MODELS** | | |
| Newfoundland & Labrador | 1.91 (0.97 - 3.34) | 1.33 (0.71-2.48) |
| Manitoba | 9.18 (3.63-23.16) | 5.11 (1.91-13.66) |
| Saskatchewan | 1.93 (0.56-6.69) | 1.98 (0.57-6.86) |
| Alberta | 3.81 (2.56-5.58) | 3.02 (2.04-4.50) |
| TOTAL PRIVATE | 3.17 (2.46-4.10) | 2.28 (1.74-2.99) |
| **GOVERNMENT CANNABIS RETAIL MODELS** | | |
| Prince Edward Island | [b] | [b] |
| Nova Scotia | 8.59 (2.08-35.40) | 5.83 (1.37-24.75) |
| New Brunswick | 3.08 (0.74-12.76) | 2.46 (0.59-10.30) |
| Quebec | 4.88 (2.26-10.54) | 2.80 (1.25-6.27) |
| Yukon | [b] | [b] |
| North West Territories | [b] | [b] |
| TOTAL PUBLIC | 3.16 (2.04-4.93) | 2.79 (1.79-4.35) |
| **GRAND TOTAL** | 3.86 (3.14-4.76) | 2.90 (2.34-3.60) |

*NB: [a]British Columbia with one public cannabis retail outlet and Ontario and Nunavut each with no physical cannabis outlets were excluded from this analysis. [b]Unstable regression model due to lack of variation in income variable. [c] Both models are offset by the total population of a dissemination area. Model B adjusts for the population density of each DA in persons per square kilometer.*