Reasons for Purchasing Cannabis From Illegal Sources in Legal Markets: Findings Among Cannabis Consumers in Canada and U.S. States, 2019–2020

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ABSTRACT. Objective: Nonmedical cannabis is legal in Canada and several U.S. states. Displacing the illegal market is a primary goal of legalization; however, there are little data on factors that predict consumers' transition from the illegal to the legal market. The current study aimed to examine reasons for purchasing illegal cannabis and, thus, potential barriers to purchasing legal cannabis among consumers in Canada and U.S. states. **Method:** Data are from the 2019 and 2020 International Cannabis Policy Study, a repeat cross-sectional survey conducted among 16- to 65-year-olds. Reasons for purchasing illegally in the past 12 months were asked of male and female cannabis consumers in Canada and U.S. legal states (n = 11,659). Changes over time in reasons for illegal purchasing were tested. Analyses among Canadians also examined associations between reasons for illegal purchasing and objective data on cannabis prices and retail density. **Results:** In both years, the most commonly reported barriers to legal purchasing were price (Canada: 35%–36%; United States: 27%) and inconvenience (Canada: 17%–20%; U.S.: 16%–18%). In 2020 versus 2019, several factors were less commonly reported as barriers in Canada, including inconvenience (17% vs. 20%, p = .011) and location of legal sources (11% vs. 18%, p < .001). Certain barriers increased in the United States, including slow delivery (5% vs. 8%, p = .002) and requiring a credit card (4% vs. 6%, p = .008). In Canada, consumers in provinces with more expensive legal cannabis were more likely to report price as a barrier, and those in provinces with fewer legal retail stores were more likely to report inconvenience as a barrier (p < .001). **Conclusions:** Higher prices and inconvenience of legal sources were common barriers to purchasing legal cannabis. Future research should examine how perceived barriers to legal purchasing change as legal markets mature. (*J. Stud. Alcohol Drugs, 83,* 392–401, 2022)

THE LEGALIZATION OF medical and nonmedical cannabis has occurred in Canada and the United States in recent decades. Nonmedical cannabis was legalized in Canada in October 2018 (Government of Canada, 2019), the second country after Uruguay in 2014 (El Senado y la Cámara de Representantes de la República Oriental del Uruguay, 2013). In the United States, medical cannabis has been legalized in 36 states, and although nonmedical ("recreational") cannabis remains a Schedule I Controlled Substance at the federal level, it has been legalized in more than 18 states plus the District of Columbia at the time of writing (National Conference of State Legislatures, 2022).

One of the goals of nonmedical cannabis legalization in Canada is to displace the illegal cannabis market with legal, regulated retail sources (Government of Canada, 2021). Reports from the United States have demonstrated that the size of the illegal market varies across states that have legalized recreational cannabis (herein "legal" states). In Washington State, 3 years after legal retail stores opened, overall demand estimates were greater than supply records, suggesting that a sizable amount of cannabis was still sourced from the illegal market (Caulkins et al., 2019). In Oregon, biannual reports suggest that legal supply exceeds demand estimates, which has led to low prices; it is assumed that some extent of illegal market persists in Oregon, but estimates are missing (Oregon Liquor Control Commission, 2019, 2021). Moreover, news reports frequently highlight the continued existence of the illegal market in legal states (Markus, 2019; Queally & McGreevy, 2019; Solis, 2021). Canadian data suggests that approximately 41% of Canadian consumers usually obtained cannabis from legal stores in 2020—up from 24% in 2019—and 13% usually obtained cannabis from legal websites in both years (Health Canada, 2019, 2020). Although the increase in purchasing from legal storefronts is promising, this suggests that up to half of consumers are still purchasing cannabis illegally 2 years after legalization.

Few studies have examined why consumers purchase from the illegal market—in other words, barriers to legal purchasing—in a legalized context (Fataar et al., 2021; Health Canada, 2019, 2020; Statistics Canada, 2019b). In the national Canadian Cannabis Survey, consumers reported that price, quality/safe supply, and convenience were the leading factors influencing where consumers sourced their cannabis (Health Canada, 2019, 2020). A U.S. study found that consumers in legal states generally had positive views of the legal cannabis market, and that perceptions were more

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positive in states with more mature retail markets (Fataar et al., 2021). No studies to our knowledge have compared reasons for illegal purchasing between countries or states/provinces.

The price of legal cannabis likely has an important influence on whether consumers transition from illegal to legal retail sources. Research among cannabis consumers in Canada and the United States demonstrated in a hypothetical marijuana purchasing task that when legal cannabis cost the same or marginally higher than illegal cannabis, consumers preferred legal cannabis and the demand for illegal cannabis was reduced (Amlung & MacKillop, 2019; Amlung et al., 2019). Consumers viewed legal cannabis as a superior product to illegal cannabis, suggesting that even a slightly higher legal price than illegal could still encourage consumer transition to the legal market (Amlung & Mackillop, 2019). However, another study concluded that, when considering the substitutability between illegal and legal cannabis, the socially optimal price of legal cannabis should be lower than the illegal price to be competitive (Childs & Stevens, 2019). The price of cannabis is theorized to reduce after legalization (Hall & Lynskey, 2016), and a decrease in prices after legalization has been shown in several jurisdictions, e.g., Oregon (Oregon Liquor Control Commission, 2019), Washington (Caulkins et al., 2018; Smart et al., 2017), Colorado (Orens et al., 2018), and Canada (Statistics Canada, 2019a). However, there is evidence to suggest that prices in Canada were declining before legalization (Statistics Canada, 2018). To discourage increased consumption associated with low prices, regulators may choose to control the retail price of cannabis using taxes or regulations surrounding production and potency (Kilmer, 2014; Pacula & Lundberg, 2014; Pardo, 2014). However, taxes that are set too high may lead to a price disparity that deters consumers from transitioning to the legal market (Kilmer, 2014). Indeed, in 2018, more than a third of consumers in U.S. legal states considered legal cannabis to be more expensive than illegal cannabis (Fataar et al., 2021).

Retail availability, including convenience and accessibility of legal sources, is another important factor influencing consumers' transition to the legal market. As a legal retail market is established, the number of retail stores tends to increase, improving the accessibility of legal cannabis and convenience of using legal sources (Statistics Canada, 2019c). However, retail market structures can influence the convenience and accessibility of cannabis. For example, municipalities can opt out of retail stores, resulting in unequal access across jurisdictions. Two years after retail stores opened in Washington State, 30% of residents lived in a community that had temporarily or permanently prohibited retail sales (Dilley et al., 2017). At the same time, availability of online and delivery services may improve access to cannabis for consumers who cannot access physical stores. The availability of online services differs in Canada and the United States: all Canadian provinces permit online sales and delivery, whereas only four U.S. states currently allow delivery services for nonmedical cannabis (Colorado General Assembly, 2019; Helling, 2022; Leafbuyer Writing Team, 2020). Previous research on changes in accessibility of cannabis post-legalization has predominantly focused on the impact on cannabis use (Everson et al., 2019; Freisthler & Gruenewald, 2014). A study examining pre- versus post-opening of nonmedical cannabis stores in Los Angeles, California found that the presence of a cannabis store within 4 miles of a respondent's home was associated with daily/almost daily cannabis consumption (Pedersen et al., 2021).

The current study aimed to (a) examine reasons for purchasing illegal cannabis, and thus, potential barriers to purchasing legal cannabis among consumers in Canada and the seven U.S. states with established legal retail cannabis markets as of September 2019: Alaska, California, Colorado, Massachusetts, Nevada, Oregon, and Washington; (b) examine reasons for purchasing illegal cannabis over time; and (c) examine whether consumer perceptions of price and convenience of legal cannabis sources were associated with objective measures of retail cannabis prices and the number of licensed stores, respectively, in Canadian provinces. We hypothesized that (a) price and convenience would be common reasons for purchasing illegal cannabis, (b) fewer Canadians would report inconvenience as a barrier to legal purchasing in 2020 than 2019, and (c) perceptions of higher cannabis prices and greater inconvenience of legal cannabis sources would be correlated with objective data on retail prices and number of retail stores.

Method

The data were from Waves 2–3 of the International Cannabis Policy Study (ICPS), a repeat cross-sectional study conducted in Canada and the United States among respondents ages 16–65 (Hammond et al., 2020). Data were collected via self-completed web-based surveys conducted in September–October 2019 and 2020 (1 and 2 years after legalization in Canada). Respondents were recruited through the Nielsen Consumer Insights Global Panel and their partners' panels. Email invitations (with a unique link) were sent to a random sample of panelists (after targeting for age and country criteria); ineligible panelists were not invited. Surveys were conducted in English in the United States and English or French in Canada. Median survey time was 25 min in 2019 and 21 min in 2020. Respondents provided consent before completing the survey. Respondents received remuneration in accordance with their panel's usual incentive structure (e.g., points-based or monetary rewards, chances to win prizes). The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#31330). A full description of the study methods can be found in the ICPS methodology paper

Table 1. Sample characteristics of cannabis consumers who had indicated a reason for purchasing illegal cannabis, 2019–2020 (n = 11,659)

	Canada		U.S. states[a]	
Variable	2019 (n = 3,586) % (n)	2020 (n = 2,988) % (n)	2019 (n = 3,119) % (n)	2020 (n = 1,966) % (n)
Sex				
Female	45.8% (1,641)	47.3% (1,415)	47.0% (1,467)	46.0% (905)
Male	54.2% (1,945)	52.7% (1,573)	53.0% (1,652)	54.0% (1,061)
Age group, years				
18–25[b]	14.0% (502)	10.2% (304)	14.4% (450)	11.3% (222)
26–35	29.3% (1,051)	31.1% (929)	30.7% (957)	32.4% (637)
36–45	22.2% (798)	23.0% (688)	22.8% (710)	28.0% (550)
46–55	19.0% (682)	19.5% (581)	17.3% (541)	14.3% (281)
56–65	15.4% (553)	16.3% (486)	14.8% (461)	14.0% (276)
Ethnicity/race				
White	74.2% (2,661)	74.8% (2,234)	75.3% (2,348)	77.1% (1,516)
Other/mixed/unstated	25.8% (925)	25.2% (754)	24.7% (771)	22.9% (449)
Education level				
Less than high school	13.9% (499)	11.4% (341)	4.9% (152)	3.8% (75)
High school diploma	28.3% (1,013)	31.0%	22.2%	21.6%
Some college or technical training	36.1% (1,295)	35.5%	46.7%	43.4%
Bachelor's degree or higher	20.3% (729)	20.8%	25.8%	30.6%
Unstated[c]	1.4% (341)	1.3% (38)	0.4% (13)	0.5% (10)
Income adequacy[d]				
Very difficult/difficult	38.4% (1,378)	31.9% (953)	37.7% (1,175)	34.7% (682)
Neither easy nor difficult	32.1% (1,151)	38.0% (1,134)	31.5% (982)	33.1% (650)
Very easy/easy	26.0% (934)	27.2% (812)	27.2% (848)	30.3% (596)
Unstated	3.4% (124)	3.0% (89)	3.7% (114)	1.9% (38)
Survey device type				
Smartphone	49.3% (1,768)	50.6% (1,512)	58.9% (1,838)	56.6% (1,112)
Tablet	7.7% (275)	5.0% (149)	4.7% (148)	3.4% (68)
Computer	43.0% (1,543)	44.4% (1,327)	36.4% (1,134)	40.0% (786)
Cannabis use status				
Less than monthly, but past-12-month consumer	30.5% (1,093)	25.1% (1,093)	26.8% (836)	19.5% (383)
Monthly/weekly consumer	33.2% (1,190)	33.3% (997)	30.5% (949)	36.5% (718)
Daily/almost daily consumer	36.3% (1,303)	41.6% (1,242)	42.8% (1,334)	44.0% (865)

[a]U.S. states included Alaska, California, Colorado, Massachusetts, Nevada, Oregon, and Washington State. [b]Note that in the United States, the youngest age included was 21 years. In Canada, the youngest age was 18 years in Alberta and Quebec and 19 years in the remaining provinces. [c]Due to low cell sizes for "unstated," this category was grouped with "less than high school" in models. [d]Income adequacy was assessed by the question: "Thinking about your family's income, how difficult or easy is it to make ends meet? 'Making ends meet' means having enough money to pay for the things your family needs."

(Hammond et al., 2020) and technical reports (www.cannabisproject.ca/methods).

Measures

Sociodemographic variables included province or state of residence, sex at birth, age group, ethnicity/race, highest level of education, perceived income adequacy (assessed as "ability to make ends meet"), and survey device type (to assess methodological differences). See the ICPS Wave 3 (2020) survey for complete item wording and Table 1 for response options used in the current study (www.cannabis-project.ca/methods).

Frequency of cannabis consumption was determined based on questions on most recent and frequency of cannabis use, and coded as *less than monthly but past 12 months, monthly/weekly,* or *daily/almost daily consumer.*

Purchasing illegal cannabis was assessed among past-12-month cannabis consumers by asking, "Overall, how much of the marijuana that you used in the past 12 months was purchased from legal/authorized sources?" Those who entered a value less than 100% were asked about their reasons for purchasing illegal cannabis, described below. Those who selected "Don't know" or "Refuse" were considered illegal purchasers if they selected "illegal or unauthorized store/dispensary" and/or "illegal or unlicensed website" in a previous question regarding their purchase source in the past 12 months. Consumers who entered a value less than 100% but sourced their cannabis legally for free (e.g., gifting small amounts through friends) were able to report that they did not purchase illegally (see below). This question focused on the purchase of cannabis, which would exclude sharing between consumers, which is permitted in Canada and U.S. legal states.

Reasons for purchasing illegal cannabis were assessed among cannabis consumers who had purchased at least some of their cannabis from an illegal source. Consumers were asked, "What were the main reasons you bought marijuana

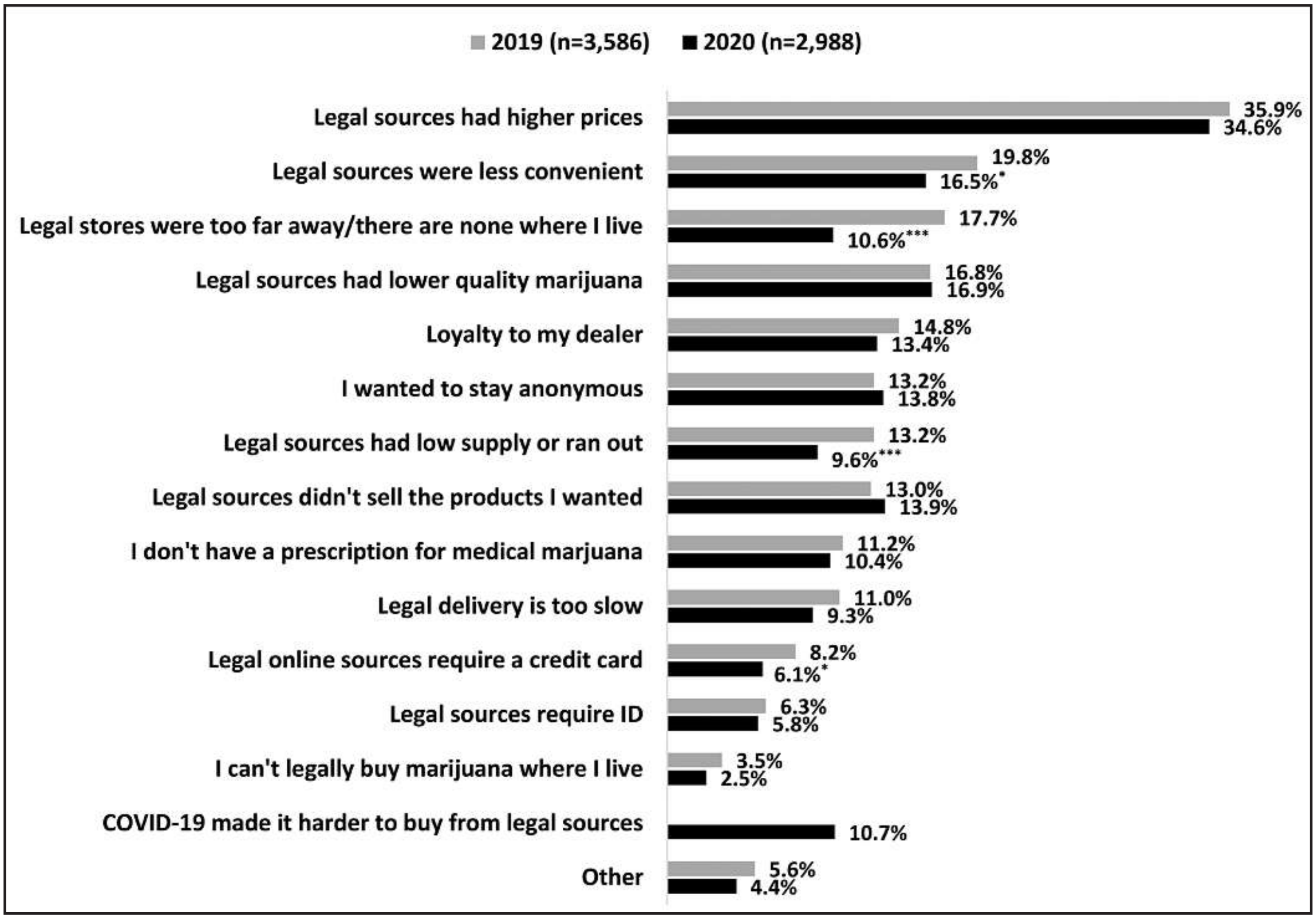

Figure 1. Main reasons for purchasing cannabis from illegal sources among cannabis consumers in Canada. *Asterisks indicate significant differences from 2020 (*$p < .05$; **$p < .01$; ***$p < .001$), tested using chi-square test.

from illegal/unauthorized sources instead of legal/authorized sources?" followed by a list (Figure 1). Consumers could also select "Not applicable – I didn't purchase marijuana from an illegal/unauthorized source," "Don't know," or "Refuse."

Price of cannabis was represented by the mean price of legal dried flower in each Canadian province (continuous variable). These data were collected from a scan of the legal retail market in Sept.–Dec. 2019 and March–May 2020. Briefly, prices for approximately 20,000 products were collected from physical and online cannabis stores in Canada, using previously published methodology (Mahamad & Hammond, 2019; Mahamad et al., 2020). Sensitivity analyses were conducted wherein price models were run using three different estimates of price for each province: the mean, median, or 10th percentile of cannabis price. No difference in R^2 values was observed; therefore, only models using mean price are reported.

Stores per capita was calculated for each Canadian province in September 2019 and 2020 to correspond with the data collection dates of the ICPS surveys. The total number of licensed legal stores was identified from official government lists in each province (e.g., https://aglc.ca/cannabis/licensed-producers). The number of stores per capita was calculated by dividing the total population of each province by the number of legal stores.

Data analysis

The final cross-sectional samples comprised 47,735 and 45,680 respondents in 2019 and 2020, respectively. Post-stratification sample weights were constructed based on the Canadian and U.S. Census estimates. Separately for Canada, U.S. legal states, and U.S. illegal states, a raking algorithm was applied to the cross-sectional analytic samples (45,735 and 45,680 in 2019, and 2020, respectively) to compute weights that were calibrated to the groupings used in the raking algorithm for each year and jurisdiction. Weights were rescaled to the sample size for Canada, U.S. legal states, and U.S. illegal states. See the ICPS technical reports for further detail on exclusions and weighting (www.cannabisproject.ca/methods). Estimates are weighted unless otherwise reported.

For the current analysis, respondents below the minimum legal age (MLA) for nonmedical cannabis in their province or state (n = 6,870) were excluded.[1] Next, respondents living in U.S. states that had not legalized nonmedical cannabis (n = 22,783) and legal states that had not yet initiated a legal sales market in September 2019 (n = 1,748) were excluded, leaving 51,936 respondents in Canada, Alaska, California, Colorado, Massachusetts, Nevada, Oregon, and Washington State. After excluding respondents who had not used cannabis in the past 12 months (n = 32,846), who reported purchasing from legal online or physical retail stores as their only cannabis source (n = 4,366), or reported that they did not purchase cannabis from an illegal source (n = 3,065), the current sample comprised 11,659 respondents in Canada and the United States who had purchased illegal cannabis in 2019 and 2020.

The reasons for purchasing illegal cannabis in each jurisdiction were described using descriptive statistics. Two binary logistic regression models were conducted among Canadian respondents to test the odds of reporting that (a) “legal sources had higher prices” and (b) “legal sources were less convenient” (1 = *yes* vs. 0 = *no;* excluding “don’t know” and “refuse”). Model 1 was adjusted for mean price of legal cannabis, and model 2 was adjusted for number of legal stores per capita. Both models were adjusted for age group, sex, education level, ethnicity/race, income adequacy, survey device type, and frequency of cannabis use. These models were not conducted among U.S. respondents because of a lack of data on objective prices and stores per capita. Analyses were conducted using survey procedures in SAS version 9.4 (SAS Institute Inc., Cary, NC).

Results

Sample characteristics among those who indicated a reason for purchasing illegal cannabis are shown in Table 1. Approximately half of the sample was female, and more than half had at least some college/technical or university education.

Reasons for purchasing illegal cannabis

Figures 1 and 2 show the reasons for purchasing illegal cannabis in Canada and the United States, respectively. In 2020, price was the most common barrier to legal purchasing, selected by 35% of consumers in Canada and 27% in the United States. The second most common barrier in 2020 was inconvenience of legal sources (Canada: 17%; United States: 16%). This was tied with product quality in Canada (17%); product quality was less commonly cited in the United States (9%). The third most common response was product selection in Canada (14%) and loyalty to one’s dealer in the United States (13%). The COVID-19 pandemic was also reported as a reason for illegal purchasing by 11% of consumers in Canada and 15% in the United States.

Changes over time

In Canada, fewer respondents cited inconvenience as a barrier at 2 years versus 1 year after legalization (20% vs. 17%, p = .011). This was also the case for store location (18% vs. 11%, p < .001), low supply (13% vs. 10%, p < .001), and legal sources requiring a credit card (8% vs. 6%, p = .023). In the United States, changes tended go in the opposite direction: More respondents reported low quality as a barrier from 2019 to 2020 (7% vs. 9%, p = .036), as did low supply (6% vs. 8%, p = .042), slow delivery (5% vs. 8%, p = .002), and requiring a credit card (4% vs. 6%, p = .008).

Provincial and state differences in reasons for illegal purchasing

Provincial- and state-level estimates of reasons for illegal purchasing are shown in Supplemental Figures A and B. In Canada (Supplemental Figure A), price was the most commonly selected reason for illegal purchasing in all provinces. (Supplemental material appears as an online-only addendum to this article on the journal’s website.) Ordering of the remaining responses tended to differ across provinces: in 2020, the location or inconvenience of legal sources was the second most common barrier to legal purchasing in provinces such as Ontario, New Brunswick, and Nova Scotia, whereas lower quality of legal cannabis was the second most common barrier in provinces such as British Columbia, Alberta and Newfoundland and Labrador. Loyalty to one’s dealer was the second most common reason in Quebec, Saskatchewan, and Manitoba. Results from Prince Edward Island are not described because of low sample sizes.

In the United States (Supplemental Figure B), price was the most common factor in all legal U.S. states. Inconvenience was the second most common factor in most states. However, in Colorado, it was approximately as important as price, and in Massachusetts, it was approximately as important as having a prescription for medical cannabis, perhaps because of the novelty of the legal retail market (late 2018). In Oregon and Washington, inconvenience was the second most important factor in 2019, but it became less of an issue in 2020, perhaps because of the COVID-19 pandemic. Differences in ordering of the remaining response options were more pronounced for U.S. states than Canadian provinces.

[1]In U.S. legal states, MLA was defined as age 21. In Canada, MLA was defined as age 18 for those in Alberta; ages 18 and 21 for those in Quebec in 2019 and 2020, respectively; and age 19 for those in all other provinces. Note that the province of Quebec raised their minimum legal age for cannabis from 18 to 21 years on January 1, 2020.

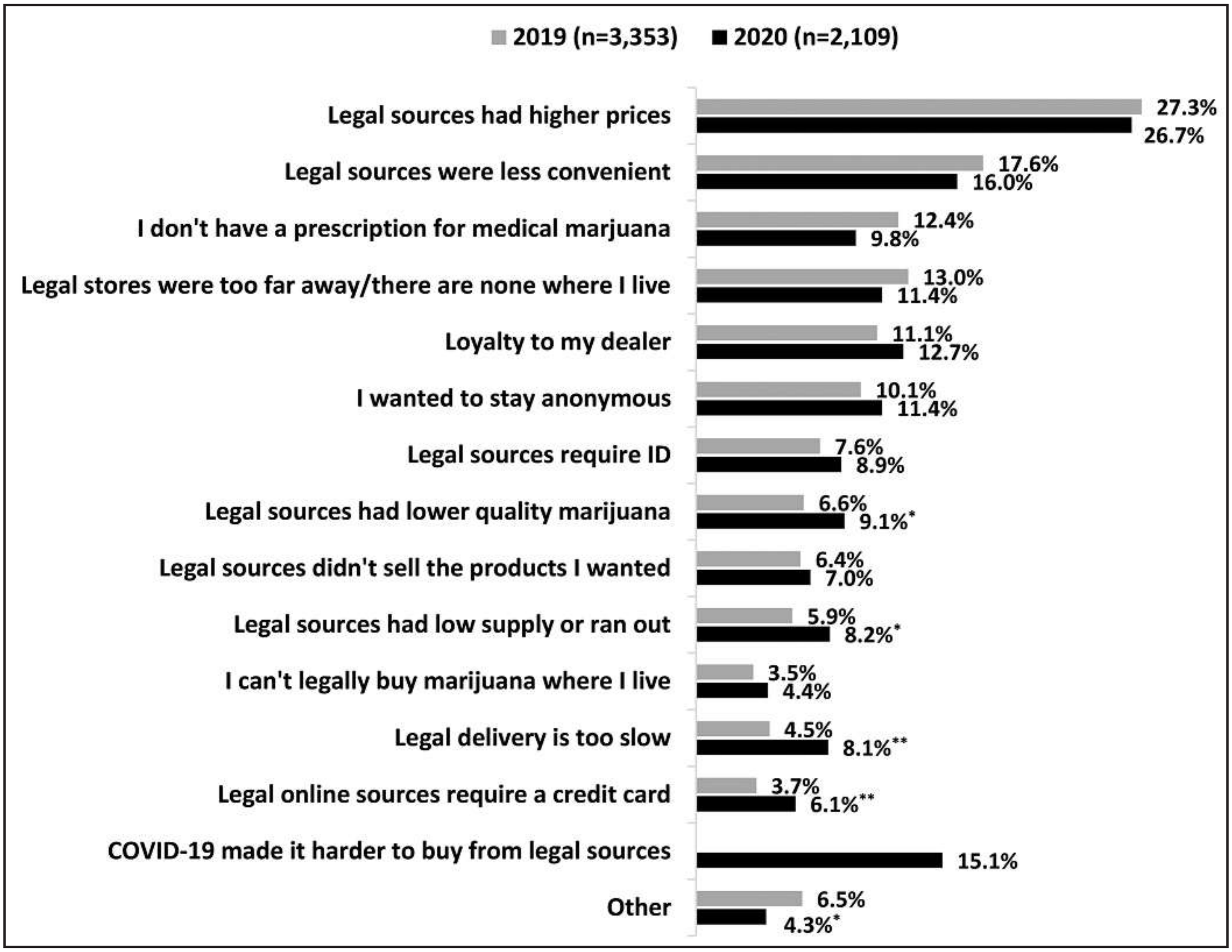

FIGURE 2. Main reasons for purchasing cannabis from illegal sources among cannabis consumers in U.S. states with legal retail markets. *Asterisks indicate significant differences from 2020 (* $p < .05$; ** $p < .01$; *** $p < .001$), tested using chi-square test.

Odds of reporting price and inconvenience as barriers among Canadian consumers

Logistic regression models were fit to examine correlates for the two most common reasons for purchasing cannabis from an illegal source: price and inconvenience (Table 2).

Price. Among consumers in Canada who had purchased illegal cannabis (n = 6,041), consumers who lived in provinces with higher prices of legal dried flower were more likely to report higher prices as a barrier (adjusted odds ratio [AOR] = 1.21, 95% CI [1.13, 1.29], $p < .001$). Consumers who used cannabis weekly/monthly (AOR = 2.44, 95% CI [1.98, 3.00], $p < .001$) or daily/almost daily (AOR = 5.56, 95% CI [4.54, 6.82], $p < .001$) were also significantly more likely to report higher prices as a barrier compared with less-than-monthly consumers. In addition, the following groups were more likely to report higher prices as a barrier: males versus females (AOR = 1.26, 95% CI [1.09, 1.46], $p = .002$); White respondents versus those identifying as other/mixed/unstated (AOR = 1.23, 95% CI [1.03, 1.47], $p = .020$); those with some college or technical training versus less than a high school education (AOR = 1.36, 95% CI = [1.06, 1.76], $p = .017$); and those who reported that it was difficult/very difficult to make ends meet versus easy/very easy (AOR = 1.35, 95% CI [1.11, 1.64], $p = .002$). There were no main effects of age ($p = .736$) or survey device ($p = .392$).

Inconvenience. Among consumers in Canada who had purchased illegal cannabis (n = 6,041), consumers who lived in provinces with fewer legal retail stores per capita were more likely to report inconvenience as a barrier (AOR = 1.07, 95% CI [1.04, 1.10], $p < .001$). Consumers who used cannabis weekly/monthly (AOR = 2.14, 95% CI [1.68, 2.72], $p < .001$) or daily/almost daily (AOR = 2.83, 95% CI [2.23, 3.60], $p < .001$) were also significantly more likely to report

Table 2. Weighted logistic regression models examining correlates for the two most common reasons for purchasing cannabis from illegal source: price and inconvenience (n = 6,041)

	Odds of reporting price as a reason for purchasing illegally		Odds of reporting inconvenience as a reason for purchasing illegally	
Variable	AOR [95% CI]	*p*	AOR [95% CI]	*p*
Mean price of cannabis	1.21 [1.13, 1.29]	<.001	–	–
Stores per capita	–	–	0.93 [0.91, 0.96]	<.001
Cannabis use status				
Less than monthly, but Past-12-month consumer	ref.	–	ref.	–
Monthly/weekly consumer	2.44 [1.98, 3.00]	<.001	2.14 [1.68, 2.72]	<.001
Daily/almost daily consumer	5.56 [4.54, 6.82]	<.001	2.83 [2.23, 3.60]	<.001
Sex				
Female	ref.	–	ref.	–
Male	1.26 [1.09, 1.46]	.002	1.24 [1.04, 1.48]	.015
Age group, years				
18–25[a]	ref.	–		
26–35	0.92 [0.72, 1.17]	.484	0.92 [0.70, 1.22]	.565
36–45	0.85 [0.67, 1.09]	.205	0.78 [0.59, 1.04]	.086
46–55	0.91 [0.71, 1.18]	.478	0.77 [0.57, 1.04]	.092
56–65	0.85 [0.65, 1.12]	.251	0.72 [0.52, 0.99]	.046
Ethnicity/race				
White	1.23 [1.03, 1.47]	.020	1.13 [0.92, 1.39]	.239
Other/mixed/unstated	ref.	–	ref.	–
Education level				
Less than high school	ref.	–	ref.	–
High school diploma	1.21 [0.94, 1.64]	.125	1.34 [0.94, 1.90]	.103
Some college or technical training	1.36 [1.06, 1.76]	.017	1.75 [1.27, 2.40]	.001
Bachelor's degree or higher[b]	1.13 [0.85, 1.49]	.416	1.62 [1.15, 2.27]	.006
Income adequacy[c]				
Very difficult/difficult	1.35 [1.11, 1.64]	.002	1.39 [1.12, 1.74]	.003
Neither easy nor difficult	1.10 [0.91, 1.33]	.346	1.22 [0.98, 1.52]	.081
Very easy/easy	ref.	–		
Unstated	0.69 [0.42, 1.14]	.142	1.30 [0.71, 2.36]	.400
Survey device type				
Smartphone	ref.	–	ref.	–
Tablet	0.88 [0.65, 1.20]	.419	1.03 [0.72, 1.48]	.853
Computer	1.07 [0.91, 1.26]	.394	1.02 [0.84, 1.23]	.842

Notes: AOR = adjusted odds ratio; 95% CI = 95% confidence interval; ref. = reference category. [a]The youngest age was 18 years in Alberta and Quebec and 19 years in the remaining provinces. [b]Due to low cell sizes for "unstated," this category was grouped with "less than high school" in models. [c]Income adequacy was assessed by the question: "Thinking about your family's income, how difficult or easy is it to make ends meet? 'Making ends meet' means having enough money to pay for the things your family needs."

inconvenience as a barrier to purchasing legal cannabis compared with less-than-monthly consumers. In addition, the following groups were more likely to report inconvenience as a barrier: males versus females (AOR = 1.24, 95% CI [1.04, 1.48], p = .015); those with some college or technical training (AOR = 1.75, 95% CI [1.27, 2.40], p = .001) or a bachelor's degree or higher (AOR = 1.62, 95% CI [1.15, 2.27], p = .006) versus those with less than a high school education; and those who reported that it was difficult/very difficult to make ends meet versus easy/very easy (AOR = 1.39, 95% CI [1.12, 1.74], p = .003). There were no main effects of age (p = .166), ethnicity/race (p = .239), or survey device (p = .971).

Discussion

The study findings indicate that price and inconvenience of legal sources were key reasons for purchasing from the illegal cannabis market in both Canada and the United States. In Canada, store location and product quality were also commonly reported reasons for not using the legal market. These findings are largely consistent with data from national Canadian monitoring surveys in which price, quality, safe supply, convenience and accessibility or location were commonly reported as barriers to legal purchasing (Health Canada, 2019, 2020; Statistics Canada, 2019b). Although comparative national-level data are unavailable for the United States, one study found that young adults who participated in an online cannabis purchase task were sensitive to both the price and the quality of cannabis (Vincent et al., 2017). Regarding quality and safety, fewer consumers reported quality as a barrier in U.S. legal states compared with Canada, regardless of the maturity of the state's retail market (Supplemental Figure B).

Overall, the findings suggest that consumers are sensitive to the price differential between legal and illegal cannabis, as well as differences in accessibility of legal versus illegal sources. Recent research suggests that the discrepancy between legal and illegal prices is narrowing in Canada (Wadsworth et al., 2022). Moreover, since we conducted the current study, additional price decreases in the legal retail market have occurred, which may reduce price as a barrier in future years. Of note, the current findings indicated that consumers living in Canadian provinces with higher average cannabis prices were more likely to report price as a barrier, as were daily or weekly/monthly versus less frequent consumers. This suggests that consumers have an accurate assessment of legal cannabis prices and may respond to price declines to encourage transition to the legal market, or price increases to discourage initiation or heavier consumption. Indeed, daily/almost daily consumers account for a significant proportion of the market share, so measures to encourage frequent consumers to transition are important (Callaghan et al., 2019). Cannabis regulatory agencies in Canadian provinces and legal states will need to balance consumer demand for lower prices with the public health priority of maintaining a minimum price threshold or increasing taxes to discourage overconsumption (Pacula & Lundberg, 2014; Pacula et al., 2014; Pardo, 2014). In addition, more frequent consumers and those living in Canadian provinces with fewer stores per capita (i.e., lower access to legal sources) were more likely to cite the inconvenience of legal sources as a barrier to legal purchasing. Indeed, research has demonstrated that legal purchasing ranges across the provinces and those who live closer to retail stores have a higher likelihood of purchasing legally (Wadsworth et al., 2021). As the number of stores per capita increases with the growing retail market, these factors are expected to become less of a barrier to transitioning to legal sources. This is demonstrated by the significant decrease from 2019 to 2020 in Canadian consumers reporting inconvenience and stores being too far away; indeed, the number of retail stores in Canada increased in the first 2 years after legalization (Statistics Canada, 2019c). It is also reflected to some extent in findings from the United States. With some exceptions (e.g., Colorado), consumers in states with more established (i.e., older) retail markets (e.g., Oregon and Washington) were generally less likely to cite inconvenience as a barrier compared to states with more recent retail markets, such as Massachusetts and California (Supplemental Figure B). This is consistent with a previous study finding that U.S. respondents in legal states with more established retail markets were more likely to report that, compared with illegal cannabis, legal cannabis was "more convenient to buy" (Fataar et al., 2021).

After we adjusted for cannabis use frequency, male consumers were significantly more likely than females to report both price and inconvenience as barriers to legal purchasing in Canada. Similarly, in the 2019 National Cannabis Survey, a greater proportion of males than females cited price, accessibility, and location as their primary factors when purchasing cannabis. More males than females also considered anonymity and availability of preferred strain, whereas twice as many females as males cited sales support as being important when purchasing cannabis (Statistics Canada, 2019b). Future research should examine sex differences regarding consumers' transition from the illegal to the legal market.

Our findings also indicated that low supply and unavailability of one's preferred product(s) were each reported as barriers by about 1 in 10 consumers in Canada in 2020. Similarly, in the 2020 Canadian Cannabis Survey, 17% of consumers reported that cannabis products were "always" or "often" unavailable from legal provincially regulated retailers (Health Canada, 2020). This finding is likely reflective of two factors. For one, most product categories with the exception of dried flower and orally ingested cannabis oils (e.g., drops and capsules) were unavailable until more than 1 year after legalization in Canada (in December/January 2020). Thus, consumers looking to purchase edibles, hash/kief, or other extracts such as vape oils and topical products may have reported that their preferred products were unavailable. Second, product supply issues at legal retail stores were at play at the time of the study. Indeed, there has been extensive media coverage regarding supply issues in the 2 years since Canada implemented legal sales (Mazur, 2019). In Canada's most populous province, the provincial online retailer encountered numerous supply issues (Ontario Cannabis Store, 2020). This was coupled with a lottery system that permitted a limited number of physical retail stores to open in the first 2 years after legalization, resulting in limited availability of legal products across Ontario (George-Cosh, 2019; Safayeni, 2019). The number of stores per capita in Ontario has begun to rise in conjunction with increasing authorization rates for private storefronts (Alcohol and Gaming Commission of Ontario, 2021). This change is evident from the current study, in which the proportion of consumers in Ontario selecting "Legal stores were too far away/there are none where I live" declined by almost half from 2019 to 2020 (Supplemental Figure A).

Differences in reasons for illegal purchasing between 2019 and 2020 also may have been affected by the COVID-19 pandemic. More than 1 in 10 consumers in both countries reported that the COVID-19 pandemic was a barrier to legal purchasing in 2020, suggesting that this may have hindered some legal purchasing and/or delayed the transition to the legal market in Canada and U.S. states with more recent retail markets. At the same time, legal cannabis became available via delivery and/or curbside pickup in several Canadian provinces and some U.S. states during the pandemic (George-Cosh, 2020; Krane, 2020). In Canada, this may have contributed to the observable decreases in consumers reporting slow delivery time (11% to 9%) and inconvenience (20% to 17%) of legal sources as barriers to legal purchasing in 2020 versus 2019. In the United States, the proportion citing inconvenience as a barrier also decreased slightly (18% to 16%), whereas slow delivery time increased significantly from 5% to 8%. It is possible that supply chain issues during the pandemic contributed to shipping delays in some states (Bobrow, 2020).

Limitations

This study is subject to limitations common to survey research. Respondents were recruited using non–probability-based sampling; therefore, the findings do not provide nationally representative estimates. The data were weighted to the national population by age group, sex, region, and education, in both countries and region-by-race in the United States. However, compared with the national population, the U.S. sample had fewer respondents with low education levels and Hispanic ethnicity. In both countries, the ICPS sample also had poorer self-reported general health compared with the national population, which is a feature of many non-probability samples (Fahimi et al., 2018) and may be partly attributable to the use of web surveys, which provide greater perceived anonymity than in-person or telephone-assisted interviews often used in national surveys (Hays et al., 2015). In addition, stores per capita was selected as a proxy measure for availability of physical storefronts in Canada but does not reflect regional differences within each province, such as the lower number of stores per capita typical of rural versus urban areas. Finally, regression models were conducted in Canada but not the United States because of objective data availability.

Conclusions

Higher prices and inconvenience were cited by consumers as common barriers to sourcing cannabis from legal retail sources in jurisdictions that had legalized recreational cannabis in Canada and the United States. As markets mature, the number of stores per capita tends to increase, and inconvenience is expected to become less of a hurdle. Regulators will need to balance public health and criminal justice priorities in order to establish a competitive market price for legal cannabis that encourages legal purchasing.

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References

Alcohol and Gaming Commission of Ontario. (2021, February 16). The AGCO now issuing 30 cannabis Retail Store Authorizations per week. Retrieved from https://www.agco.ca/blog/cannabis/feb-2021/agco-now-issuing-30-cannabis-retail-store-authorizations-week

Amlung, M., & MacKillop, J. (2019). Availability of legalized cannabis reduces demand for illegal cannabis among Canadian cannabis users: Evidence from a behavioural economic substitution paradigm. *Canadian Journal of Public Health, 110,* 216–221. doi:10.17269/s41997-018-0160-4

Amlung, M., Reed, D. D., Morris, V., Aston, E. R., Metrik, J., & MacKillop, J. (2019). Price elasticity of illegal versus legal cannabis: A behavioral economic substitutability analysis. *Addiction, 114,* 112–118. doi:10.1111/add.14437

Bobrow, W. (2020, April 14). COVID-19's impact on the cannabis cultivation supply chain. *Forbes.* Retrieved from https://www.forbes.com/sites/warrenbobrow/2020/04/14/covid-19s-impact-on-the-cannabis-cultivation-supply-chain/?sh=49d9770a4331

Callaghan, R. C., Sanches, M., Benny, C., Stockwell, T., Sherk, A., Kish, S. J. (2019). Who consumes most of the cannabis in Canada? Profile of cannabis consumption by quantity. *Drug and Alcohol Dependence, 205,* 107587. doi:10.1016/j.drugalcdep.2019.107587

Caulkins, J. P., Bao, Y., Davenport, S., Fahli, I., Guo, Y., Kinnard, K., . . . Kilmer, B. (2018). Big data on a big new market: Insights from Washington State's legal cannabis market. *International Journal of Drug Policy, 57,* 86–94. doi:10.1016/j.drugpo.2018.03.031

Caulkins, J. P., Davenport, S., Doanvo, A., Furlong, K., Siddique, A., Turner, M., & Kilmer, B. (2019). Triangulating web & general population surveys: Do results match legal cannabis market sales? *International Journal of Drug Policy, 73,* 293–300. doi:10.1016/j.drugpo.2019.06.010

Childs, J., & Stevens, J. (2019). The state must compete: Optimal pricing of legal cannabis. *Canadian Public Administration, 62,* 656–673. doi:10.1111/capa.12352

Colorado General Assembly. (2019). *HB19-1234: Regulated Marijuana Delivery.* Retrieved from http://leg.colorado.gov/bills/HB19-1234

Dilley, J. A., Hitchcock, L., McGroder, N., Greto, L. A., & Richardson, S. M. (2017). Community-level policy responses to state marijuana legalization in Washington State. *International Journal of Drug Policy, 42,* 102–108. doi:10.1016/j.drugpo.2017.02.010

El Senado y la Cámara de Representantes de la República Oriental del Uruguay, r. e. A. G. (2013). *Ley No. 19.172. Marihuana y sus Derivados: Control y Regulación del Estado de la Importación, Producción, Adquisición, Almacenamiento, Comercialización y Distribución.* Retrieved from http://www.pensamientopenal.com.ar/system/files/2015/09/doctrina42001.pdf

Everson, E. M., Dilley, J. A., Maher, J. E., & Mack, C. E. (2019). Post-legalization opening of retail cannabis stores and adult cannabis use in Washington State, 2009-2016. *American Journal of Public Health, 109,* 1294–1301. doi:10.2105/AJPH.2019.305191

Fahimi, M., Barlas, F., & Thomas, R. (2018, February 13). Practical guide for surveys based on nonprobability samples [Webinar]. Retrieved from https://www.aapor.org/Education-Resources/Online-Education/Webinar-Details.aspx?webinar=WEB0218

Fataar, F., Goodman, S., Wadsworth, E., & Hammond, D. (2021). Consumer perceptions of 'legal' and 'illegal' cannabis in US states with legal cannabis sales. *Addictive Behaviors, 112,* 106563. doi:10.1016/j.addbeh.2020.106563

Freisthler, B., & Gruenewald, P. J. (2014). Examining the relationship between the physical availability of medical marijuana and marijuana use across fifty California cities. *Drug and Alcohol Dependence, 143,* 244–250. doi:10.1016/j.drugalcdep.2014.07.036

George-Cosh, D. (2019, November 21). Ontario mulls overhauling pot shop system in 2020 as sales lag. *BNN Bloomberg.* Retrieved from https://www.bnnbloomberg.ca/ontario-mulls-overhauling-pot-licence-system-in-2020-as-sales-lag-source-1.1351505

George-Cosh, D. (2020, November 20). Ontario to permit cannabis delivery, curbside pickup in lockdown regions. *BNN Bloomberg.* Retrieved from https://www.bnnbloomberg.ca/ontario-to-permit-cannabis-delivery-curbside-pickup-in-lockdown-regions-1.1525711

Government of Canada. (2019). *Cannabis Regulations (SOR/2018-144).*

Cannabis Act. Controlled Drugs and Substances Act. Food and Drugs Act. Retrieved from https://laws-lois.justice.gc.ca/eng/regulations/SOR-2018-144/FullText.html

Government of Canada. (2021). *Cannabis legalization and regulation.* Retrieved from http://www.justice.gc.ca/eng/cj-jp/cannabis/

Hall, W., & Lynskey, M. (2016). Evaluating the public health impacts of legalizing recreational cannabis use in the United States. *Addiction, 111,* 1764–1773. doi:10.1111/add.13428

Hammond, D., Goodman, S., Wadsworth, E., Rynard, V., Boudreau, C., & Hall, W. (2020). Evaluating the impacts of cannabis legalization: The International Cannabis Policy Study. *International Journal of Drug Policy, 77,* 102698. doi:10.1016/j.drugpo.2020.102698

Hays, R. D., Liu, H., & Kapteyn, A. (2015). Use of Internet panels to conduct surveys. *Behavior Research Methods, 47,* 685–690. doi:10.3758/s13428-015-0617-9

Health Canada. (2019). *The Canadian Cannabis Survey 2019 Detailed Data Tables.* Retrieved from http://epe.lac-bac.gc.ca/100/200/301/pwgsc-tpsgc/por-ef/health/2019/130-18-e/index.html

Health Canada. (2020). *2020 Canadian Cannabis Survey (CCS) Detailed Tables.* Retrieved from https://epe.lac-bac.gc.ca/100/200/301/pwgsc-tpsgc/por-ef/health/2020/114-19-e/CCS2020_DetailedTables_ENG.pdf

Helling, B. (2022, January 20). *A state-by-state guide to marijuana delivery.* Retrieved from https://gigworker.com/marijuana-delivery/

Kilmer, B. (2014). Policy designs for cannabis legalization: Starting with the eight Ps. *American Journal of Drug and Alcohol Abuse, 40,* 259–261. doi:10.3109/00952990.2014.894047

Krane, K. (2020, March 18). How the coronavirus pandemic will affect the cannabis industry. *Forbes.* Retrieved from https://www.forbes.com/sites/kriskrane/2020/03/18/how-the-coronavirus-pandemic-will-affect-the-cannabis-industry/?sh=3bc95c0b5adf

Leafbuyer Writing Team. (2020, August 13). State-by-state guide to marijuana delivery services. Retrieved from https://www.leafbuyer.com/blog/state-by-state-guide-to-marijuana-delivery-services/

Mahamad, S., & Hammond, D. (2019). Retail price and availability of illicit cannabis in Canada. *Addictive Behaviors, 90,* 402–408. doi:10.1016/j.addbeh.2018.12.001

Mahamad, S., Wadsworth, E., Rynard, V., Goodman, S., & Hammond, D. (2020). Availability, retail price and potency of legal and illegal cannabis in Canada after recreational cannabis legalisation. *Drug and Alcohol Review, 39,* 337–346. doi:10.1111/dar.13069

Markus, B. (2019, June 24). Marijuana is legal in Colorado, but the illegal market still exists. *NPR.* Retrieved from https://www.npr.org/2019/06/24/735510378/marijuana-is-legal-in-colorado-but-the-illegal-market-still-exists

Mazur, A. (2019, July 5). Canada's cannabis supply issues are real, despite feds' denial, says business professor. *Global News.* Retrieved from https://globalnews.ca/news/5463653/canadas-cannabis-supply-feds-denial/

National Conference of State Legislatures. (2022). *State medical cannabis laws.* Retrieved from https://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx

Ontario Cannabis Store. (2020). *A year in review (2019-2020): Ontario's first full year of legal cannabis operations.* Retrieved from https://regulatorwatch.com/wp-content/uploads/2020/07/Cannabis-OCS-InsightsReport_2019-2020.pdf

Oregon Liquor Control Commission. (2019). *2019 Recreational Marijuana Supply and Demand Legislative Report.* Retrieved from https://www.oregon.gov/olcc/marijuana/Documents/Bulletins/2019%20Supply%20and%20Demand%20Legislative%20Report%20FINAL%20for%20Publication(PDFA).pdf

Oregon Liquor Control Commission. (2021). *2021 Recreational Marijuana Supply and Demand Legislative Report.* Retrieved from https://www.oregon.gov/olcc/Docs/Legislative_docs/2021-Supply-and-Demand-Report.pdf

Orens, A., Light, M., Lewandowski, B., Rowberry, J., & Saloga, C. (2018). Market size and demand for marijuana in Colorado: 2017 Market update. Retrieved from https://www.colorado.gov/pacific/sites/default/files/MED%20Demand%20and%20Market%20%20Study%20%20082018.pdf

Pacula, R. L., Kilmer, B., Wagenaar, A. C., Chaloupka, F. J., & Caulkins, J. P. (2014). Developing public health regulations for marijuana: Lessons from alcohol and tobacco. *American Journal of Public Health, 104,* 1021–1028. doi:10.2105/AJPH.2013.301766

Pacula, R. L., & Lundberg, R. (2014). Why changes in price matter when thinking about marijuana policy: A review of the literature on the elasticity of demand. *Public Health Reviews, 35,* 1–18. doi:10.1007/BF03391701

Pardo, B. (2014). Cannabis policy reforms in the Americas: A comparative analysis of Colorado, Washington, and Uruguay. *International Journal of Drug Policy, 25,* 727–735. doi:10.1016/j.drugpo.2014.05.010

Pedersen, E. R., Firth, C. L., Rodriguez, A., Shih, R. A., Seelam, R., Kraus, L., . . . D'Amico, E. J. (2021). Examining associations between licensed and unlicensed outlet density and cannabis outcomes from preopening to postopening of recreational cannabis outlets. *American Journal on Addictions, 30,* 122–130. doi:10.1111/ajad.13132

Queally, J., & McGreevy, P. (2019, September 11). Nearly 3,000 illegal marijuana businesses found in California audit, dwarfing legal trade. *Los Angeles Times.* Retrieved from https://www.latimes.com/california/story/2019-09-11/california-marijuana-black-market-dwarfs-legal-pot-industry

Safayeni, D. (2019, December 23). Change needs to come faster for Ontario cannabis. *Policy Options.* Retrieved from https://policyoptions.irpp.org/magazines/december-2019/the-province-is-on-the-right-track-but-it-cant-afford-to-wait-four-years-to-get-1000-stores-and-its-retailers-need-a-direct-line-to-producers/

Smart, R., Caulkins, J. P., Kilmer, B., Davenport, S., & Midgette, G. (2017). Variation in cannabis potency and prices in a newly legal market: Evidence from 30 million cannabis sales in Washington State. *Addiction, 112,* 2167–2177. doi:10.1111/add.13886

Solis, J. (2021, January 13). Marijuana is legal in Nevada, but illegal market is still huge, officials say. *Nevada Current.* Retrieved from https://www.nevadacurrent.com/2021/01/13/marijuana-is-legal-in-nevada-but-illegal-market-is-still-huge-officials-say/

Statistics Canada. (2018). *Cannabis consumer prices. Table 18-10-0211-01.* Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810021101

Statistics Canada. (2019a). *Cannabis Stats Hub. Cannabis implicit price index, Canada. Third quarter 2020.* Retrieved from https://www150.statcan.gc.ca/n1/pub/13-610-x/cannabis-eng.htm

Statistics Canada. (2019b). *National Cannabis Survey, second quarter 2019.* Retrieved from https://www150.statcan.gc.ca/n1/daily-quotidien/190815/dq190815a-eng.htm

Statistics Canada. (2019c). *The retail cannabis market in Canada: A portrait of the first year.* Retrieved from https://www150.statcan.gc.ca/n1/pub/11-621-m/11-621-m2019005-eng.htm

Vincent, P. C., Collins, R. L., Liu, L., Yu, J., De Leo, J. A., & Earleywine, M. (2017). The effects of perceived quality on behavioral economic demand for marijuana: A web-based experiment. *Drug and Alcohol Dependence, 170,* 174–180. doi:10.1016/j.drugalcdep.2016.11.013

Wadsworth, E., Driezen, P., & Hammond, D. (2021). Retail availability and legal purchases of dried flower in Canada post-legalization. *Drug and Alcohol Dependence, 225,* 108794. doi:10.1016/j.drugalcdep.2021.108794

Wadsworth, E., Driezen, P., Pacula R.L., & Hammond, D. (2022). Cannabis flower prices and transitions to legal sources after legalization in Canada, 2019–2020. *Drug and Alcohol Dependence, 231,* 109262. doi:10.1016/j.drugalcdep.2021.109262