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Original quantitative research

Noticing of cannabis health warning labels in Canada and the US

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Abstract

Introduction: Product labelling and health warnings are important components of regulatory frameworks for consumer products such as tobacco, alcohol and food. However, evidence in the cannabis domain is limited. This study aimed to examine the reach of mandated health warnings on cannabis products using a natural experimental design.

Methods: Data are from the online International Cannabis Policy Study 2018 and 2019 surveys. Respondents were men and women aged 16 to 65 years in Canada and US states with illegal and legal nonmedical cannabis ("illegal" and "legal" states, respectively) (n = 72 549). Regression models tested differences in noticing health warnings on cannabis packages pre- and post-legalization in Canada, with comparisons to US states, adjusting for cannabis use, cannabis source and sociodemographics.

Results: Respondents in Canada showed a greater increase in noticing warnings (+8.9%) in 2019 (14.7%) versus 2018 (5.8%) than respondents in US "illegal" states (+2.8%) and "legal" states (+3.2%). In 2019, consumers residing in jurisdictions with legal recreational cannabis who purchased from legal retail sources were more likely to report noticing warnings than consumers who obtained cannabis from illegal/unstated sources (Canada: 40.4% vs. 15.3%; US "legal" states: 35.3% vs. 17.0%). Regular cannabis consumers were more likely to notice warnings than less frequent consumers.

Conclusion: Mandating warning labels on cannabis products may increase exposure to messages communicating the health risks of cannabis, especially among frequent consumers and those who access the legal market.

Keywords: *health warnings, cannabis, North America*

Highlights

- The aim of this study was to examine noticing of mandated health warnings on cannabis products.
- Compared to respondents in US states, respondents in Canada noticed more health warnings after nonmedical cannabis legalization in 2019 versus pre-legalization in 2018.
- Purchasing cannabis from legal sources was associated with increased noticing of health warnings.
- Regular cannabis consumers were more likely to notice warnings than less frequent consumers.
- Mandating warning labels on cannabis products may increase exposure to messages communicating the health risks of cannabis, especially among frequent consumers and those who access the legal market.

Introduction

Product labelling and health warnings are important components of regulatory frameworks for consumer products such as tobacco, alcohol and food. Health warnings on packages are particularly important due to both the frequency and timing of the consumer's exposure; the latter typically occurs at the point of purchase and immediately preceding use.[1,2] However, the influence of health warnings depends largely upon their design. Small, obscure warnings have relatively little influence compared with larger, more comprehensive warnings.[1] Several factors can enhance the effectiveness of labels, including increased size, the use of pictorial images, and distinctive design factors that enhance legibility and salience.[1,3]

Regulations for mandated warnings on cannabis products are at an early stage due to the recency of legal cannabis markets. In Canada, nonmedical cannabis was legalized on 17 October 2018, along with regulations that required health warnings on all cannabis packages.[4,5] Warnings must be displayed on the principal display area, written in black type on a yellow background, using a font size equal to or larger than the brand name and larger than that of the product information, and must feature a black border[4] (Figure 1). Different warning messages are rotated across products, each of which describes a different health effect. While formatting requirements remain

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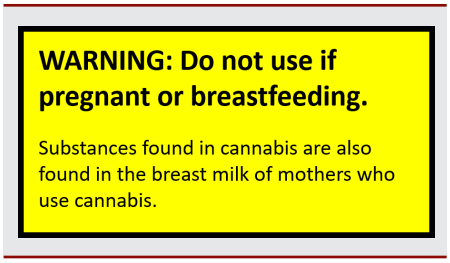
FIGURE 1.
Example of a Canadian cannabis health warning label in effect from 17 October 2018 to 17 October 2019



the same, the warning label messages were revised one year post-legalization, with nine revised warnings implemented on 17 October 2019, near the end of the 2019 study period, which ended October 31, 2019.[5] In both the original and revised versions, the warnings related to cannabis smoke, pregnancy or breastfeeding, driving or operating machinery, mental health, risk among adolescents and young adults, high THC content and—in 2019 onward—delayed effects of edibles.

In the US, although recreational cannabis remains a Schedule I Controlled Substance at the federal level, adult use has been legalized in an increasing number of states since 2012. As of September 2019, retail cannabis sales were legal in seven states, all of which required at least one mandatory health warning label on their products at the time of writing. Unlike the mandatory warnings in Canada, none of the states requires rotating warning content. Most US warnings are printed in black type on a white background, and may appear as a block of text that summarizes several health risks in one paragraph. In addition, several states, including those that have prohibited nonmedical cannabis, require health warnings on medical cannabis, with varying requirements across states.[6]

There are relatively few studies on cannabis health warnings, given their relative novelty. Experimental, or "pre-implementation," research indicates high levels of public support for mandatory warnings.[7] Large, comprehensive warnings also have the potential to reduce the appeal of cannabis products, including among young people.[7-9] A survey conducted with cannabis consumers in Canada and the US in the year following nonmedical cannabis legalization in Canada showed survey respondents six text-based warnings.[10] One-third of cannabis consumers indicated they would be "happy" to see health warning messages on cannabis products, and each of the warning messages was rated as believable by between half and three-quarters of consumers. Compared to consumers in the US, those in Canada reported higher levels of support and believability, and perceived the health information as less novel.

As an increasing number of jurisdictions consider legalizing nonmedical cannabis, there is a need to examine the effectiveness of health warnings in population-based studies that evaluate the naturalistic "real-world" effect of warnings. As a first step, there is a need to examine the extent to which mandated warnings are salient among consumers. The concept of "noticing" is a fundamental and necessary first step within conceptual frameworks for health warnings. Put simply, health warnings must be noticed before they can improve health knowledge and influence consumer behaviour.[1,2,11] Noticing has been assessed in conceptual models examining how health warnings can influence consumer behaviour, and is a function of the size, position and visual salience of warnings, as well as frequency of exposure.[1,11,12] Indeed, research suggests that pack-a-day smokers are exposed to packages—and thus health warnings where mandated—about 7300 times per year.[13] For product domains such as cannabis, which have very high levels of illicit sales even within legalized markets, the extent to which consumers purchase from regulated retail sources may be an important determinant of exposure to mandated health warnings.

The aim of this study was to examine whether residing in Canada would be associated with increased self-reported noticing of health warning labels pre- versus post-legalization, compared to residing in US states that had or had not legalized recreational cannabis ("legal" and "illegal" states, respectively). It was hypothesized that a greater increase in noticing health warnings would be observed in Canada post-legalization of cannabis, compared to US "legal" states. It was further hypothesized that rates of noticing would be relatively stable in US "illegal" states (comparison group), where recreational cannabis is not available for legal purchase.

Methods

Data are cross-sectional findings from Waves 1 and 2 of the International Cannabis Policy Study (ICPS)[14] conducted in Canada and the US. Data were collected via self-completed web-based surveys conducted in fall 2018, immediately before cannabis legalization in Canada, and fall 2019 with respondents aged 16 to 65 years. Respondents were recruited through the Nielsen Consumer Insights Global Panel and their partners' panels using nonprobability methods. Email invitations (with a unique link) were sent to a random sample of panellists after targeting for age and country criteria. Panellists known to be ineligible were not invited.

Surveys were conducted in English in the US and English or French in Canada. Median survey times were 20 and 25 minutes in 2018 and 2019, respectively. Respondents provided consent before completing the survey. Respondents received remuneration in keeping 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). The survey underwent pilot testing, and a full description of the study methods can be found in the ICPS Technical Reports and methodology paper.[14-18]

Measures

Full question wording is available in the ICPS surveys (http://cannabisproject.ca/methods/).

Sociodemographic factors

Sociodemographic factors included sex, age, ethnicity, highest education level and perceived income adequacy (all categorical variables). Suspected device type used to complete the survey was collected by Nielsen. See Table 1 for response options.

Noticing of cannabis health warning labels

Noticing of cannabis health warning labels was assessed using the question "In the past 12 months, have you seen health warnings on marijuana products or packages?" (Yes; No; Not applicable – I have not seen any marijuana products or packages; Don't know; Refuse to answer).

TABLE 1
Sample characteristics, International Cannabis Policy Study 2018 and 2019, weighted (n = 72 549)

	CANADA				US "ILLEGAL" STATES[a]				US "LEGAL" STATES[b]			
	2018 (pre-legalization) (n = 10 018)		2019 (post-legalization) (n = 15 151)		2018 (n = 9692)		2019 (n = 10 231)		2018 (n = 7358)		2019 (n = 20 099)	
	%	n	%	n	%	n	%	n	%	n	%	n
Sex												
Female	50.0	5 006	49.8	7 547	50.4	4 883	50.3	5 150	49.8	3 665	49.8	10 019
Male	50.0	5 012	50.2	7 604	49.6	4 808	49.7	5 081	50.3	3 693	50.2	10 081
Age												
16–25	18.9	1 894	18.6	2 824	19.9	1 933	19.9	2 034	19.4	1 429	19.7	3 957
26–35	20.6	2 066	20.8	3 157	21.4	2 069	21.5	2 198	22.9	1 685	22.6	4 551
36–45	19.6	1 963	19.8	3 002	18.9	1 835	19.1	1 950	17.4	1 279	19.3	3 886
46–55	20.8	2 088	20.0	3 025	20.2	1 954	19.8	2 027	21.8	1 605	19.5	3 912
56–65	20.0	2 008	20.7	3144	19.6	1 900	19.8	2 022	18.5	1 360	18.9	3 794
Ethnicity												
White	77.4	7 758	73.4	11 116	76.4	7 407	76.1	7 787	76.4	5 622	76.3	15 329
Other/mixed/unstated	22.6	2 261	26.6	4 035	23.6	2 284	23.9	2 444	23.6	1 736	23.7	4 771
Highest education level												
Unstated	0.7	73	1.0	150	0.3	27	0.4	36	0.4	32	0.4	79
Less than high school	15.5	1 549	15.4	2 333	15.2	1 474	12.1	1 237	11.8	865	5.1	1 015
High school diploma	26.6	2 666	26.5	4 017	19.4	1 880	22.5	2 304	15.8	1 164	20.2	4 067
Some college/technical training	32.4	3 242	32.4	4 911	38.4	3 717	36.4	3 725	42.0	3 090	41.7	8 385
Bachelor's degree or higher	24.8	2 488	24.7	3 740	26.8	2 593	28.6	2 928	30.0	2 207	32.6	6 553
Income adequacy (difficulty making ends meet)												
Unstated	3.4	346	3.8	576	2.0	199	2.5	259	2.9	216	3.1	615
Very difficult	8.2	822	9.7	1 463	9.3	901	10.6	1 088	8.9	655	10.0	2 018

Continued on the following page

TABLE 1 (continued)
Sample characteristics, International Cannabis Policy Study 2018 and 2019, weighted (n = 72 549)

	CANADA				US "ILLEGAL" STATES[a]				US "LEGAL" STATES[b]			
	2018 (pre-legalization) (n = 10 018)		2019 (post-legalization) (n = 15 151)		2018 (n = 9692)		2019 (n = 10 231)		2018 (n = 7358)		2019 (n = 20 099)	
	%	n	%	n	%	n	%	n	%	n	%	n
Difficult	20.0	2 002	22.2	3 368	22.2	2 156	23.2	2 378	19.5	1 438	22.6	4 550
Neither easy nor difficult	35.9	3 601	35.0	5 308	31.5	3 053	33.0	3 381	32.2	2 370	33.2	6 673
Easy	21.2	2 122	19.7	2 984	22.0	2 132	19.0	1 946	22.9	1 682	19.9	4 009
Very easy	11.2	1 125	9.6	1 452	12.9	1 251	11.5	1 180	13.5	996	11.1	2 234
Cannabis use status[c]												
Not in past 12 months	72.6	7 275	64.9	9 836	76.3	7 394	69.5	7 109	66.0	4 856	61.1	12 287
Past 12-month user	8.6	862	11.3	1 717	6.9	672	8.1	831	9.3	685	10.1	2 022
Monthly user	4.8	485	6.9	1 053	5.2	507	6.1	624	6.8	499	6.3	1 272
Weekly user	5.1	507	5.6	850	4.1	397	4.7	482	6.6	485	6.2	1 252
Daily/almost daily user	8.9	889	11.2	1 696	7.4	721	11.6	1 185	11.3	833	16.3	3 266
Cannabis source												
Legal source	2.2	220	18.2	2 760	1.4	136	2.0	208	19.1	1 407	23.6	4 739
Illegal/unstated source	25.2	2 523	16.9	2 555	22.3	2 161	28.5	2 914	14.9	1 094	15.3	3 073
Not used in past 12 months	72.6	7 275	64.9	9 836	76.3	7 394	69.5	7 109	66.0	4 856	61.1	12 287
Suspected survey device type												
Smartphone[d]	0.0	0	42.7	6 475	0.0	0	51.9	5 306	0.0	0	52.7	10 598
Tablet	10.8	1081	9.5	1 442	7.5	730	6.2	638	10.9	801	5.9	1 183
Computer	89.2	8 937	47.7	7 234	92.5	8 961	41.9	4 287	89.1	6 557	41.4	8 318

Note: Percentages may not total to 100 due to rounding.

[a] US states in which nonmedical cannabis is illegal.

[b] US states in which nonmedical cannabis is legal.

[c] Mutually exclusive categories. A "past 12-month user" is a respondent who indicated use in past 12 months, but not more recently.

[d] Use of smartphones to complete survey was prohibited in the 2018 (Wave 1) survey.

Cannabis use status

Cannabis use status was assessed by asking about most recent and current cannabis use (coded into the following exclusive categories: Not in past 12 months; In past 12 months but not more recently; Monthly use; Weekly use; Daily/almost daily use; Don't know; Refuse to answer).

Cannabis source

Cannabis source was assessed by asking past 12-month cannabis consumers, "In the past 12 months, have you gotten any type of marijuana from the following sources?" Response options were Made or grew my own; Family member or friend; Dealer; Internet delivery or mail order; Store, co-op or dispensary (Select all that apply), with follow-up questions to indicate authorized/legal versus unauthorized/illegal website or store if either of the latter two options were selected. Cannabis source was recoded to a binary variable (1 = legal source; 0 = illegal/unstated source). Coding of legal versus illegal sources is available upon request.

Data analysis

The final 2018 and 2019 cross-sectional samples comprised 27 169 and 45 735 respondents, respectively, for a combined total of 72 904 respondents. A subsample of 72 549 were included in the analysis after excluding respondents who refused to answer the question on noticing of health warning labels on cannabis products. Post-stratification sample weights were constructed based on Canadian and US census estimates and a raking algorithm applied; see the ICPS Technical Reports for details.[15,16] Weights were rescaled to the sample size for Canada and US "legal" states and "illegal" states. Estimates are weighted unless otherwise specified.

Binary logistic regression was used to test for differences in prevalence of noticing health warning labels (1 = Noticed cannabis health warning labels; 0 = Did not notice health warning labels/Not applicable/Don't know) between the three jurisdictions over time: fall 2018 (immediately before legalization in Canada) versus fall 2019, one year after legalization. Interactions between survey wave and jurisdiction were tested in subsequent model steps. Models were adjusted for time, age, sex, education, ethnicity, income adequacy, frequency of cannabis use and survey device type; 95% confidence intervals (95% CIs) and adjusted odds ratios (AORs) are reported. A threshold of $p < 0.05$ was used for significance. A subsequent model was conducted among cannabis users only, adjusting for the same covariates plus cannabis source. Analyses were conducted using survey procedures in SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Sample characteristics are shown in Table 1. Within each jurisdiction, respondents were about equally distributed in terms of sex and age group. Mean respondent age (SD) was 40.3 (14.7) years. Most respondents identified as White and had at least a high school diploma.

Effect of time, jurisdiction and cannabis use on noticing health warnings

The prevalence of noticing health warnings by sociodemographic characteristics and other tested covariates among all respondents is shown in Table 2. The overall prevalence of noticing health warnings over time by jurisdiction is shown in Figure 2. Overall, respondents in Canada showed a greater increase in noticing warnings (+8.9%) in 2019 versus 2018 than respondents in US "illegal" states (+2.8%) and "legal" states (+3.2%).

Results of the regression model indicated a significant interaction between survey year and jurisdiction ($F(2,72649) = 41.37$, $p < 0.001$), such that the increase in noticing health warnings in 2019 (post-legalization) versus 2018 (pre-legalization) was greater in Canada compared to US "illegal" states (AOR = 2.02, 95% CI = 1.65–2.49, $p < 0.001$) and US "legal" states (AOR = 2.34, 95% CI = 1.93–2.83, $p < 0.001$). There was no effect of survey year in US "illegal" versus "legal" states ($p = 0.150$).

The main effects model also showed a significant effect of cannabis use status ($F(4,72,647) = 386.18$, $p < 0.001$). Compared to those who had not consumed cannabis in the past 12 months, past 12-month (AOR = 1.88, 95% CI = 1.70–2.08, $p < 0.001$), monthly (AOR = 3.12, 95% CI = 2.78–3.49, $p < 0.001$), weekly (AOR = 3.59, 95% CI = 3.20–4.03, $p < 0.001$), and daily/almost daily (AOR = 4.76, 95% CI = 4.38–5.19, $p < 0.001$) cannabis consumers were more likely to report noticing health warning labels.

Effect of cannabis source on noticing health warnings

The prevalence of noticing warnings by cannabis source among past 12-month cannabis consumers is shown in Figure 3. In 2019, consumers residing in juriss dictions with legal recreational cannabis who purchased from legal retail sources were also more likely to report noticing warnings than consumers who obtained cannabis from illegal/unstated sources

FIGURE 2
Percentage of respondents noticing cannabis health warning labels, International Cannabis Policy Study, 2018 and 2019 (n = 72 549)

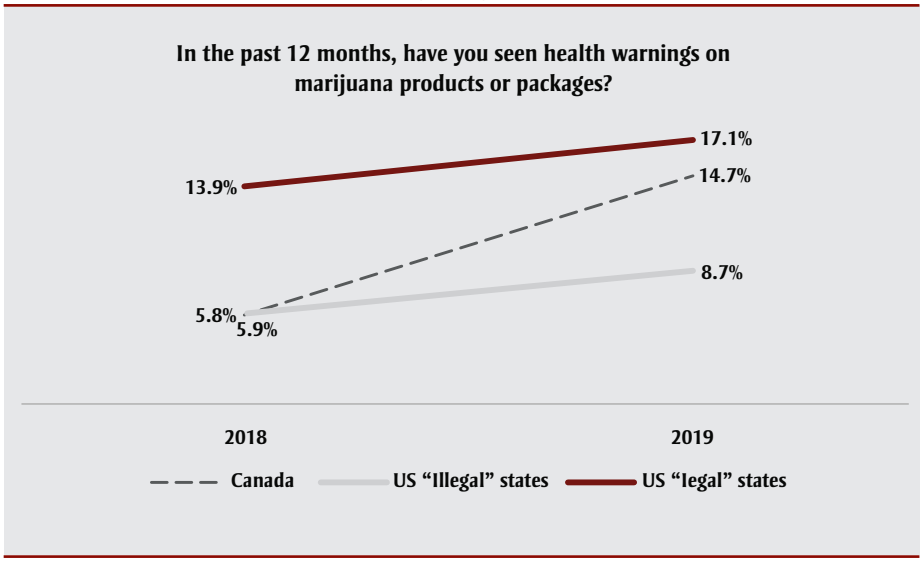


TABLE 2
Percentage of respondents noticing health warning labels by tested covariates, International Cannabis Policy Study 2018 and 2019

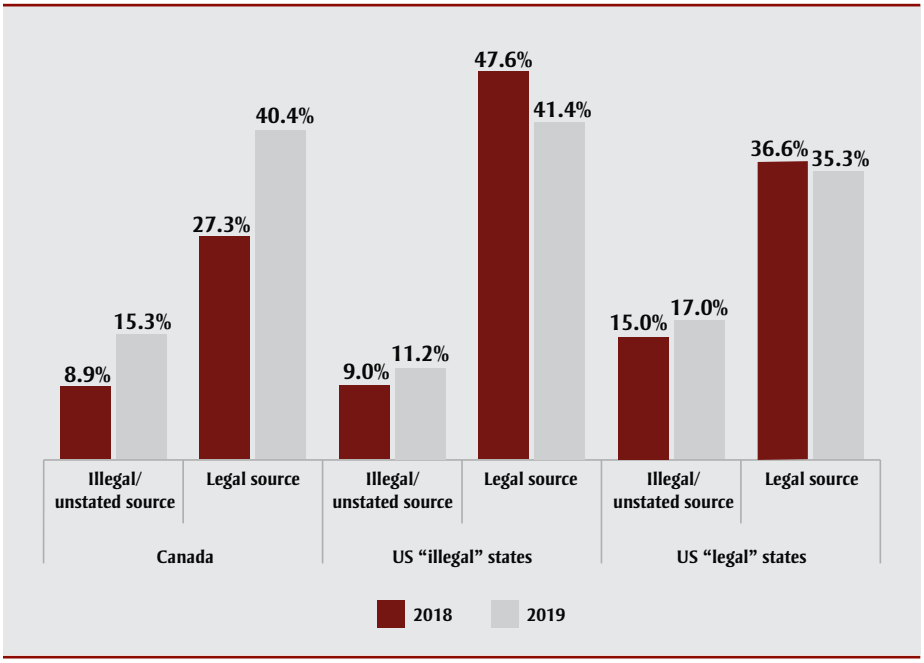
	CANADA		US "ILLEGAL" STATES[a]		US "LEGAL" STATES[b]	
	2018 (pre-legalization) (n = 10 018) %	2019 (post-legalization) (n = 15 151) %	2018 (n = 9692) %	2019 (n = 10 231) %	2018 (n = 7358) %	2019 (n = 20 099) %
Sex						
Female	4.6	11.8	3.8	6.8	11.5	14.1
Male	7.1	17.7	8.1	10.6	16.3	20.2
Age						
16–25	7.5	19.4	5.1	10.7	14.1	23.9
26–35	7.8	23.2	10.2	13.6	22.6	23.6
36–45	6.6	15.3	8.5	10.3	18.0	16.6
46–55	4.2	9.6	4.5	5.4	7.6	11.8
56–65	3.2	6.3	1.1	3.0	6.3	8.4
Ethnicity						
White	5.1	13.1	5.6	7.4	14.8	16.6
Other/mixed/unstated	8.1	19.2	7.1	12.7	11.0	18.9
Highest education level						
Unstated	13.1	6.9	14.2	1.5	0.0	3.3
Less than high school	6.5	13.2	3.2	4.5	9.5	17.5
High school diploma	5.4	15.3	4.3	8.9	12.5	17.9
Some college/technical training	5.6	15.2	4.8	7.7	13.3	16.8
Bachelor's degree or higher	5.9	14.6	10.3	11.5	17.4	17.2
Income adequacy (difficulty making ends meet)						
Unstated	5.7	7.4	4.9	4.0	6.4	7.3
Very difficult	6.6	17.4	5.0	9.8	11.7	20.1
Difficult	5.3	15.2	4.0	6.6	12.1	16.5
Neither easy nor difficult	5.1	14.1	5.3	7.0	12.7	15.9
Easy	6.8	14.3	6.3	9.7	16.7	17.5
Very easy	6.7	16.7	10.9	16.0	17.4	21.4
Cannabis use status[c]						
Not in past 12 months	4.1	7.3	4.3	6.7	7.1	10.1
Past 12-month user	5.8	18.6	8.2	8.0	15.6	17.1
Monthly user	11.2	28.3	14.2	12.2	28.5	26.0
Weekly user	10.0	30.7	12.6	15.4	29.2	30.0
Daily/almost daily user	14.5	37.0	11.3	16.4	34.6	35.1
Cannabis source						
Legal source	27.3	40.4	47.6	41.4	36.6	35.3
Illegal/unstated source	8.9	15.3	9.0	11.2	15.0	17.0
Not use in past 12 months	4.1	7.3	4.3	6.7	7.1	10.1

[a] US states in which nonmedical cannabis is illegal.

[b] US states in which nonmedical cannabis is legal.

[c] Mutually exclusive categories (e.g. a past 12-month user is a respondent who indicated using cannabis in the past 12 months, but not more recently).

FIGURE 3
Percentage of respondents noticing cannabis health warning labels by cannabis source, among past 12-month consumers, International Cannabis Policy Study 2018 and 2019 (n = 23 792)



Note: "Legal" and "illegal" US states are states in which nonmedical cannabis is legal and illegal, respectively.

(Canada: 40.4% vs. 15.3%; US "legal" states: 35.3% vs. 17.0%).

Results of the regression model show that the main effects of time and jurisdiction, as well as the interaction between time and jurisdiction, remained significant in this model ($p < 0.001$ for all), with the same pattern of results observed above (data not shown). Consumers who obtained their cannabis from a legal source were more likely to have noticed warnings than those who obtained it from an illegal/unstated source (37.1% vs. 12.7%, $p < 0.001$). There was also a significant interaction between jurisdiction and cannabis source ($F(2,22469) = 12.69$, $p < 0.001$), such that the positive effect of obtaining cannabis from a legal source was more pronounced in Canada compared to US "illegal" states (AOR = 21.71, 95% CI = 15.29–30.84, $p < 0.001$) and "legal" states (AOR = 9.40, 95% CI = 7.50–11.77, $p < 0.001$), as well as in US "illegal" versus "legal" states (AOR = 16.53, 95% CI = 11.75–23.28, $p < 0.001$). There was no three-way interaction between time, jurisdiction and cannabis source ($p = 0.731$).

The following groups were more likely to report noticing warnings: males versus females (AOR = 1.34, 95% CI = 1.22–1.46, $p < 0.001$); Other/mixed/unstated ethnic groups versus White respondents (AOR = 1.12, 95% CI = 1.00–1.25, $p = 0.044$); those with college or technical training (AOR = 1.49, 95% CI = 1.23–1.80, $p < 0.001$) or a bachelor's degree (AOR = 1.69, 95% CI = 1.38–2.06, $p < 0.001$) versus less than high school; and those who said it was "very easy" to make ends meet versus those who said it was "neither easy nor difficult" (AOR = 1.24, 95% CI = 1.05–1.45, $p = 0.009$) or who had unstated income adequacy (AOR = 2.43, 95% CI = 1.54–3.83, $p < 0.001$). Respondents aged 16 to 25 (AOR = 3.24, 95% CI = 2.77–3.80, $p < 0.001$), 26 to 35 (AOR = 2.34, 95% CI = 2.03–2.70, $p < 0.001$), 36 to 45 (AOR = 1.74, 95% CI = 1.49–2.03, $p < 0.001$) and 46 to 55 (AOR = 1.42, 95% CI = 1.21–1.66, $p < 0.001$) were also more likely to notice warnings than older adults aged 56 to 65 years. Similar to the pattern of results among all respondents, monthly (AOR = 1.45, 95% CI = 1.26–1.67, $p < 0.001$), weekly (AOR = 1.51, 95% CI = 1.31–1.75, $p < 0.001$) and daily/almost daily consumers (AOR = 1.97, 95% CI = 1.74–2.22, $p < 0.001$) were more likely to notice warning labels compared to those who consumed cannabis in the past 12 months (but not more recently). There was no effect of survey device type ($p = 0.492$).

Discussion

The results of this study suggest an increase in noticing health warnings on cannabis products after they were mandated as part of legalization of recreational cannabis in Canada. This is consistent with our hypotheses and with a recent national monitoring survey in Canada that found an increase in noticing health warnings on cannabis packages at one compared to two years post-legalization.[19] Indeed, consumers living in jurisdictions that had legalized cannabis were more likely to report noticing health warnings on packages than consumers in US "illegal" states (i.e., states where nonmedical cannabis remained illegal). Noticing warnings in 2019 was also greater among consumers who reported obtaining cannabis from legal sources. Although some products sourced through unregulated channels carry warnings—particularly if they have been diverted from legal markets—labelling of unregulated products is highly variable and unreliable.

The analysis did not examine whether the greater size and prominence of the Canadian labels improved levels of noticing relative to the mandated warnings in US states, which are generally less distinctive and prominent. However, the higher rate of noticing among those who obtained cannabis from legal sources was more pronounced in Canada than in US "legal" or "illegal" states. In addition to the more distinctive warning labels in Canada, legal cannabis products in Canada also must follow packaging requirements similar to those for "plain" or "standardized" packaging for tobacco products—including the limitation to one background colour and restrictions on brand imagery[4]—which have been shown to reduce product appeal among young people and increase perceptions of risk.[20] Future longitudinal research is required to adequately examine the effectiveness of the Canadian warnings, given the recency of the legal market in Canada, in which only a minority of consumers had transitioned to the legal market at the time of the study.

There was also a higher rate of noticing warnings among those who obtained cannabis from legal sources in US "illegal"

versus "legal" states. Although "illegal" states were originally included as a comparison group that did not have legal recreational cannabis, this finding may reflect approved medical cannabis users purchasing from medical retail stores—the only type of "legal" retail store available in these states. Medical cannabis users are likely to be more selective consumers who are particularly motivated to seek health information and engage with product warnings.

More frequent cannabis consumers were also more likely to notice warnings, which is consistent with greater exposure to cannabis packaging in general. This higher level of exposure may be particularly important given that those who use cannabis more frequently are at a greater risk of health consequences from regular use.[21]

Other sociodemographic differences were also observed, although these differences were relatively modest in magnitude and may have been driven by jurisdictional differences. For example, the few differences observed in education level were largely driven by differences among the states in which recreational cannabis remained illegal. In contrast, in legal jurisdictions with mandated warnings, levels of noticing warnings tended to be more similar across education levels (Table 2). These findings are broadly consistent with findings on tobacco warnings, which demonstrate that more prominent labels are associated with fewer differences across socioeconomic levels, particularly if warnings include pictures than do not require literacy to understand.[1] Early research of warnings on cannabis products suggests that pictorial health warnings are perceived as more effective and believable than text-based warnings.[7]

Finally, it is important to note that in Canada, only about one in five past 12-month consumers who obtained cannabis legally reported noticing health warnings. There are several possible reasons for this.

First, in most provinces, individuals can grow their own cannabis plants, and cannabis can be shared legally by another adult of legal age or a medical caregiver, either of whom may remove the product from its original packaging.[22,23] These legal sources would not provide opportunities for exposure to the warning labels.

Second, it is possible that some respondents believed an illicit cannabis retail source to be legal. Indeed, recent data show that many Canadian consumers still have trouble distinguishing between legal and illegal retail sources.[24] This would have led to lower levels of exposure among those who erroneously reported obtaining their cannabis from legal sources. However, given that there was no significant increase in noticing warning labels in US "legal" or "illegal" states—as hypothesized—the significant increase in noticing in Canada from pre- to post-legalization is noteworthy and suggests an increase in exposure after implementation of the warnings on legal products.

Third, exposure to cannabis health warnings may be more limited than is the case with warnings on other products, such as cigarettes, for which there is more extensive research. In general, cigarette packages are seen each time consumers remove a cigarette from the package,[1] whereas it is unclear whether cannabis consumers retain the original packaging of cannabis products. Among consumers of each substance, exposure to health warnings on cannabis products may therefore be lower than exposure to health warnings on cigarette packages. Future research should examine whether consumer awareness and knowledge of health warnings increase with the increasing shift from illegal to legal cannabis products in Canada, and the consequent increased exposure to warnings.

Strengths and limitations

The study benefited from a large sample size, a natural experimental design and the recruitment of participants across Canada and the US.

There were, however, some limitations. For example, the analysis examined differences between states with and without legalization of nonmedical cannabis. However, labelling policies also differ by medical cannabis legalization, which was not assessed in the study. Moreover, some states that have legalized nonmedical cannabis have yet to establish legal retail sales schemes (i.e. Vermont and the District of Columbia).[6] In addition, revised health warning labels in Canada came into effect two weeks before the end of the 2019 survey period. However, given that the central messages of the health warnings remained constant, it is unlikely that any exposure to the updated warnings influenced results among Canadian respondents.

This study was also subject to limitations common to survey research. Respondents were recruited using nonprobability sampling; therefore, the findings do not provide nationally representative estimates. The data were weighted by age group, sex, region, education and smoking status in both countries and region-by-race* in the US. However, compared to the national population, the US sample had fewer respondents with low education levels and people identifying as Hispanic.* Cannabis use estimates were within the range of national estimates for young adults, whereas estimates among the full ICPS sample were generally higher than national surveys in the US and Canada. This is likely due to the fact that the ICPS sampled individuals aged 16 to 65 years, whereas the national surveys included older adults, who are known to have lower rates of cannabis use. In both countries, the ICPS sample also had poorer self-reported general health compared to the national population, which is a feature of many nonprobability samples,[25] and may be partly due to the use of web surveys, which provide greater perceived anonymity than in-person or telephone-assisted interviews, which are often used in national surveys.[26]

Conclusion

Mandating health warning labels on cannabis products in Canada was associated with higher noticing of warnings, particularly among consumers who obtained their products from legal sources. Future research should examine the potential impact on downstream outcomes, including changes in health knowledge, perceptions of risk and social norms related to cannabis.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Authors' contributions and statement

DH conceptualized the project, sought research funding and contributed to the manuscript. SG led the analysis and manuscript writing.

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