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Do Mandatory Health Warning Labels on Consumer Products Increase Recall of the Health Risks of Cannabis?

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ABSTRACT

Introduction: Warning labels are an important source of health information. This study examined awareness of health warnings on cannabis packages over time in Canada—where large rotating messages are mandated—versus US states with legal adult-use cannabis, which have less comprehensive regulations. *Methods:* Repeat cross-sectional data were collected from the International Cannabis Policy Study online surveys among past 12-month cannabis consumers in Canada and the US ($n = 38,448$). Free recall of warning messages was assessed in 2018–2020, followed by a prompted recognition task (2020 only). Adjusted logistic regression models tested differences in free recall and recognition of warnings between Canada and US states with and without legal adult-use cannabis ("legal" and "illegal" states, respectively). *Results:* Free recall of ≥1 warning increased to a greater extent in Canada from 2018 (5%; pre-legalization) to 2019 (13%; post-legalization) compared to US "legal" (AOR = 1.93, $p < 0.001$) and "illegal" states (AOR = 1.80, $p = 0.007$), and from 2018 to 2020 (5% vs. 15%) compared to US "legal" states (AOR = 2.23, $p = 0.027$). In all jurisdictions, free recall of warnings was higher among more frequent consumers ($p < 0.001$) and those who purchased products from legal retail stores/websites ($p < 0.001$). With few exceptions, when a specific message was mandated (e.g., impaired driving), consumers were more likely to both freely recall and recognize that message (all $p < 0.05$). *Conclusions:* Cannabis legalization is associated with greater recall of health warning messages. Awareness of specific warning messages was higher in jurisdictions where the associated warning was mandated on packages, suggesting that warning labels may improve knowledge of cannabis-related health risks.

Introduction

Cannabis is one of the most commonly used drugs worldwide (Hall et al., 2016). Despite its therapeutic benefits for certain medical conditions, cannabis also presents health risks (National Academies of Sciences Engineering and Medicine, 2017; Whiting et al., 2015). The most well-established risks associated with cannabis use are related to impaired driving, mental health, pregnancy, and lung health. Frequent cannabis use and early initiation is also associated with greater risk of certain mental health conditions, poor cognitive outcomes among youth, as well as respiratory effects from long-term smoke exposure (National Academies of Sciences Engineering and Medicine, 2017).

Health warnings displayed on packaging are an important source of information on the potential health effects of consumer products (Madhavan, 2006). Research on tobacco products has demonstrated that health warnings can increase health knowledge and promote smoking cessation; however, the impact of tobacco warnings depends on their design: obscure text-only warnings have little impact, whereas large pictorial warnings are considerably more effective (Hammond, 2011).

As is the case with product labeling regulations for tobacco products, health warning standards differ across jurisdictions that have legalized cannabis in terms of warning content, design, and general scope. In Canada, warning messages came into effect when non-medical cannabis was legalized on October 17, 2018. Warnings must be displayed prominently on the principal display panel of cannabis products; be written in black font on a yellow background with a black border; the word "WARNING" must be bolded and upper case; the font size must be equal to or larger that used for the brand name; and a government attribution must be included (Government of Canada, 2019b). Each package must display a primary health warning in bold, accompanied by a secondary sentence (Supplementary Figure S1). Revised warnings were implemented on October 17, 2019 (Table 1). The revised warnings cover the same general health effects communicated by the original warnings: harms of cannabis smoke/lung health; use during pregnancy/breastfeeding; use after driving/operating machinery; risk to adolescents/young adults; and addiction/dependence (the latter was included only as a secondary sentence in the revised warnings). The revised warnings also include warnings

Table 1. Health warning labels mandatory on cannabis products in Canada.

Warning no.	Warning label text (bolded); Secondary sentences (rotated across products)
Warnings in effect October 17, 2018–October 16, 2019	
1	**WARNING: Cannabis smoke is harmful.** Harmful chemicals found in tobacco smoke are also found in cannabis smoke.
2	**WARNING: Do not use if pregnant or breastfeeding.** Using cannabis during pregnancy may harm your baby and result in low birth weight./ Substances found in cannabis are also found in the breast milk of mothers who use cannabis.*
3	**WARNING: Do not drive or operate machinery after using cannabis.** More than 4,000 Canadians were injured and 75 died from driving after using cannabis (in 2012)./ After cannabis use, coordination, reaction time and ability to judge distances are impaired.*
4	**WARNING: Cannabis can be addictive.** Up to half of people who use cannabis on a daily basis have work, social or health problems from using cannabis./ 1 in 11 people who use cannabis will become addicted./ Up to 1 in 2 people who use cannabis daily will become addicted. *
5	**WARNING: Regular use of cannabis can increase the risk of psychosis and schizophrenia.** Higher THC content can increase the risk of psychosis and schizophrenia./ Higher THC content can lower the age of onset of schizophrenia./ Young people are especially at risk. *
6	**WARNING: Adolescents are at greater risk of harms from cannabis.** Early and regular use increases the risk of psychosis and schizophrenia./ Using cannabis as a teenager can increase your risk of becoming addicted./ 1 in 6 people who start using cannabis in adolescence will become addicted. *
Warnings in effect as of October 17, 2019 **	
1	**The smoke from cannabis is harmful.** Toxic and carcinogenic chemicals found in tobacco smoke such as polyaromatic hydrocarbons, aromatic amines, and N-heterocyclics are also found in cannabis smoke.
2	**WARNING: Do not use if pregnant or breastfeeding.** Substances in cannabis are transferred from the mother to child and can harm your baby.
3	**WARNING: Do not drive or operate heavy equipment after using cannabis.** Cannabis can cause drowsiness and impair your ability to concentrate and make quick decisions.
4	**WARNING: Frequent and prolonged use of cannabis containing THC can contribute to mental health problems over time.** Daily or near-daily use increases the risk of dependence and may bring on or worsen disorders related to anxiety and depression.
5	**WARNING: Adolescents and young adults are at greater risk of harms from cannabis.** Daily or near-daily use over a prolonged period of time can harm brain development and function.
6	**WARNING: The higher the THC content of a product, the more likely you are to experience adverse effects and greater levels of impairment.** THC can cause anxiety and impair memory and concentration.
7	**WARNING: It can take up to 4 hours to feel the full effects from eating or drinking cannabis.** Consuming more within this time period can result in adverse effects that may require medical attention.
8	**WARNING: The effects from eating or drinking cannabis can be long-lasting.** The effects can last between 6 and 12 hours following use.

*Sentences separated by forward slashes indicate rotating secondary sentences across products. **Revised warnings came into effect on Oct 17, 2019 (two weeks before end of 2019 study period). Available from: https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/laws-regulations/regulations-support-cannabis-act/health-warning-messages.html.

related to the delayed effects of edibles, and associations between high-THC products and both cognition and mental health (the latter replaces an original warning on risk of psychosis and schizophrenia) (Government of Canada, 2019a).

In the United States (US), medical cannabis has been legalized in 36 states and District of Columbia (DC). Although non-medical cannabis remains a Schedule I Controlled Substance at the federal level, it has been legalized in more than 15 states and DC (National Conference of State Legislatures, 2021). As of September 2020, when the current study took place, retail cannabis sales were legal in eight states, all of which required at least one mandatory health warning on their products: Alaska, California, Colorado, Illinois, Maine, Michigan, Nevada, Oregon and Washington. Unlike the Canadian context, no state requires mandatory rotating warning content, nor salience-promoting features like vivid colors. The majority of state warnings are printed in black font on a white background, and may appear as a block of text which outlines several health risks in one paragraph (Supplementary Figure S2). State warnings are summarized in Table 2.

Literature on the impact of health warning labels on cannabis products is in its infancy due the recency of legal cannabis markets. To date, this literature has largely focused on consumer support, acceptance or perceptions of warnings, while several studies have examined knowledge of specific health effects of cannabis. Research conducted prior to cannabis legalization in Canada found that 88% of 16–30-year-olds supported mandatory warning labels on cannabis products (Leos-Toro et al., 2019), and that health warnings decreased cannabis product appeal compared to branded packages or those without health warnings (Leos-Toro et al., 2021). A study from the same sample found that the three "most important" negative health effects of cannabis reported by Canadian youth and young adults were effects on cognition/brain development (25%), respiratory function (24%) and addiction (16%); effects on driving/reaction time and mental health were each reported by 9% of respondents (Leos-Toro et al., 2020). A study of 16–65-year-olds conducted in 2018–2019 found that cannabis health knowledge was higher in Canada than US jurisdictions, and agreement with the health risks of cannabis was highest for questions on driving (66%–80%), pregnancy/breastfeeding (61%–71%) and addiction (51%–62%) across all jurisdictions (Goodman & Hammond, 2021b). A 2019 study, conducted after mandated warnings were implemented in Canada, found that Canadians rated information on health warnings as less novel and more believable than US respondents (Winstock et al., 2021). Finally, a recent study reported a significant increase in noticing of health warning labels on cannabis products among Canadian consumers in the first 12 months after Canada legalized recreational cannabis (Goodman & Hammond, 2021a). To date, there is little or no evidence on free recall of health warning messages at the population level, including the specific warning messages recalled and the health effects that are most salient among consumers. The

Table 2. Health warning messages mandatory on cannabis products in US "legal" states as of Sept 2019.

Content of health warning message*	States where mandatory
[Marijuana impairs concentration, coordination and judgment.] Do not/It is illegal to operate a motor vehicle or machinery while under the influence of marijuana/This product may impair the ability to drive or operate machinery; please use extreme caution	AK, CA, CO, IL, MA, MI, NV, OR, WA
This package contains cannabis, a Schedule I Controlled Substance/This is a marijuana product/Keep out of reach of children [and animals]/Not for kids/May only be possessed or consumed by adults 21 and older, and/or Universal Symbol: contains THC/marijuana/THC!	AK, CA, CO, IL, MA, MI, NV, OR, WA
Do not use cannabis while pregnant or breastfeeding/If pregnant or breastfeeding, consult a physician prior to use/ There may be additional health risks associated with the consumption of this product for women who are pregnant, breastfeeding, or planning on becoming pregnant.	AK, CA, CO, IL, MA, NV, WA
[When eaten or swallowed] the intoxicating effects of this product may be delayed by up to two hours/Be cautious. Cannabinoid edibles can take up to 2 hours or more to take effect *(Applies to edible products only)*/This product contains cannabis, and intoxication following use may be delayed 2 or more hours.	CA, CO, IL, MA, NV, OR, WA
[There is limited information on the side effects of using this product, and] there may be health risks associated with consumption of this product	AK, CO, MA, NV, WA
This product [has intoxicating effects/may cause impairment] and may be habit forming/addictive.	AK, IL, MA, NV, WA
This product contains medical marijuana and was produced without regulatory oversight for health, safety or efficacy/ This product has not been analyzed or approved by the FDA [to treat, cure or prevent any disease].	CO, MA, OR
Smoking is hazardous to your health.	IL, NV, WA
This product can expose you to marijuana smoke and myrcene, which are known to the State of California to cause cancer (CA Proposition 65).	CA
This product contains marijuana and its potency was tested with an allowable plus or minus 15%.	CO
Ingesting marijuana or marijuana products with alcohol or other drugs, including prescription medication, may result in unpredictable levels of impairment and that a person should consult with a physician before doing so.	NV
Do not eat *(applies to topical products)*.	IL, OR
Example of U.S. health warning message	
GOVERNMENT WARNING: THIS PRODUCT CONTAINS CANNABIS, A SCHEDULE I CONTROLLED SUBSTANCE. KEEP OUT OF REACH OF CHILDREN AND ANIMALS. CANNABIS PRODUCTS MAY ONLY BE POSSESSED OR CONSUMED BY PERSONS 21 YEARS OF AGE OR OLDER UNLESS THE PERSON IS A QUALIFIED PATIENT. THE INTOXICATING EFFECTS OF CANNABIS PRODUCTS MAY BE DELAYED UP TO TWO HOURS. CANNABIS USE WHILE PREGNANT OR BREASTFEEDING MAY BE HARMFUL. CONSUMPTION OF CANNABIS PRODUCTS IMPAIRS YOUR ABILITY TO DRIVE AND OPERATE MACHINERY. PLEASE USE EXTREME CAUTION.	CA

*Exact message wording varies by state. Note that Maine, Vermont and District of Columbia did not have legal sales as of Sept 2020. Warnings not included above relate to pesticide use, use for medical purposes/by medical patient only, and legal sales (e.g., product is unlawful outside [State]). FDA, U.S. Food & Drug Administration.

extent to which consumers notice and recall warnings on cannabis packages is likely to vary based on whether consumers purchase their cannabis from legal sources, given than illegally-source cannabis is unlikely to feature mandated warnings. However, we are unaware of any study that has examined this potentially important mediator of message recall.

There are various ways to assess the salience of health warnings. Free recall tasks require respondents to remember warnings without any prompts, whereas recognition tasks typically provide a list of warning messages to respondents and ask them to identify which they have seen. Free recall provides a more robust test of recall because that respondents cannot rely on the prompts provided in recognition tasks (McGuire, 1980). However, free recall tasks require a high level of respondent engagement, particularly in online or self-completed surveys, in which interviewers are not present to prompt respondents to answer open-ended questions. In contrast, recognition tasks require less engagement from respondents, but are more susceptible to desirability bias, leading to inflated recall estimates. To our knowledge, no studies have compared free recall and recognition tasks for health warnings in research on cannabis labeling.

The current study sought to examine free recall of specific health warning messages, with comparisons between Canada and US states that had and had not legalized non-medical cannabis ("legal" and "illegal" states, respectively). Recall was assessed in 2018, prior to non-medical legalization in Canada, and at 1-year and 2-years follow-up

in 2019 and 2020. It was hypothesized that: 1) overall prevalence of recalling health warning messages would be higher in both Canada and US "legal" states compared to US "illegal" states; and 2) free recall and recognition of the specific messages mandated on Canadian or US warning labels products would be higher in jurisdictions where those warnings were mandated. A secondary objective was to compare estimates based on free recall versus recognition tasks, with the hypothesis that recognition of health warnings would be significantly higher than free recall.

Materials and methods

Data are cross-sectional findings from the first three annual waves of the International Cannabis Policy Study (ICPS), conducted in Canada and the US (Hammond et al., 2020). Data were collected via self-completed web-based surveys conducted in August-October 2018 and September-October 2019 from respondents aged 16–65. A non-probability sample of respondents was recruited through the Nielsen Consumer Insights Global Panel and their partners' panels. The Nielsen panels are recruited using a variety of probability and non-probability sampling methods. For the ICPS surveys, Nielsen draws stratified random samples from the online panels, with quotas based on age and state/province of residence. Nielsen emails panelists an invitation to access the ICPS survey via a hyperlink; respondents are unaware of the survey topic

prior to accessing the link. Respondents confirm their eligibility and provide consent before completing the survey. Upon completion, respondents are transferred back to the Nielsen platform and receive remuneration in accordance with their panel's usual incentive structure. Monetary incentives have been shown to increase response rates and decrease response bias in subgroups under-represented in surveys, including disadvantaged subgroups (Groves et al., 2009). The cooperation rate, which was calculated based on AAPOR Cooperation Rate #2 as the percentage of respondents who completed the survey out of eligible respondents who accessed the survey link, was 64.2% in 2018, 62.9% in 2019, and 62.0% in 2020 (American Association for Public Opinion Research, 2016).

Surveys were conducted in English in the US and English or French in Canada. Median survey time was 20 minutes in 2018, 25 minutes in 2019, and 21 minutes in 2020. Data integrity measures included checks for "speeders" based on completion times, the quality of open-ended responses, patterns of "Don't Know/Refusal" responses, and inconsistent responses across items (American Association of Public Opinion Research (AAPOR), 2018). As an additional data integrity check, respondents were asked to identify the current month from a list toward the end of the survey to verify survey engagement.

The study was reviewed by and received ethics clearance through a University of Waterloo Ethics Committee (ORE#31330). A full description of the study methods can be found in the study's methodology paper (Hammond et al., 2020).

Measures

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

Socio-demographic factors included sex, age, ethnicity, highest education level and perceived income adequacy (all categorical variables). Device type used to complete the survey was also collected to account for methodological effects. See Table 3 for response options.

Free recall of cannabis health warning messages was assessed in 2018–2020 by asking, "In the past 12 months, have you seen health warnings on marijuana products or packages?" Respondents who answered "Yes" were asked: "We'd like to know what warnings you have seen on marijuana products or packages. Please describe the health warnings you've seen on products or packages. Describe as many as you can." Respondents were provided with by six "open text" boxes, along with options for Don't know, Refuse.

Open-ended descriptions of health warnings were coded manually. The list of Health Canada cannabis health warning messages implemented in October 2018 and 2019 were used to develop an initial coding scheme (Government of Canada, 2019a). Additional codes were identified *post hoc* as they emerged from the data. The first 500 responses were independently coded by two trained research staff who were blinded to jurisdiction and survey year, resulting in a joint probability of agreement of 93%. Discrepancies

between the two coders and any uncertainties identified by the first coder were resolved via discussion. After "invalid" responses were flagged (e.g., gibberish, irrelevant comment), a binary health warning recall variable was created, where 1 = At least 1 health warning recalled and 0 = No health warnings recalled (including "invalid" responses).

Recognition of cannabis health warning messages was assessed in 2020 by asking, "In the past 12 months, have you seen health warnings on marijuana products or packages related to any of the following health effects? Select all that apply." This was followed by a list of 11 items in randomized order: Pregnancy or breastfeeding; Driving or operating machinery; Cannabis smoke/lung health; Adolescents/young adults; Mental health (e.g., anxiety or depression); Addictive/habit-forming; Memory and concentration; Delayed effects when eating/drinking cannabis; Mixing with alcohol or other drugs; Cancer; and Stroke. Stroke was included as a false "control" item. Respondents could also select "None of the above," "Don't know" or "Refuse to answer." Eight of the 11 warnings aligned with the Canadian health warning messages, and seven aligned with messages mandated in at least one US "legal" state.[1] The recognition task was conducted immediately following the free recall task. Respondents were prevented from returning to the previous screen.

Cannabis purchase source was assessed by asking, "In the past 12 months, have you gotten any type of marijuana from the following sources?" (Made or Grew my own; Family member or Friend; Dealer; Internet delivery or mail order; Store, co-op or dispensary), with follow-up questions to indicate authorized/legal versus unauthorized/illegal website or store if the latter options were selected. Cannabis source was coded as 1 = Purchased from a legal/authorized store/website; 0 = Illegal/Other/Unstated source.[2]

Cannabis use frequency was measured by asking, "How often do you use marijuana"? (Less than once per month, One or more times per month, One or more times per week, Every day or almost every day).

Data analysis

The final cross-sectional samples comprised a total of 118,584 respondents (2018 = 27,169; 2019 = 45,735; 2020 = 45,680). The current analysis was conducted on a sub-sample of 38,448 past 12-month cannabis consumers, after non-consumers ($n = 79,440$) and respondents who refused to answer the question on free recall of cannabis health warning labels ($n = 696$). Post-stratification sample weights were constructed based on age group, sex, region, education level, smoking status and race (in the US) using census estimates, and a raking algorithm applied. See the ICPS Technical Reports for more detail (http://cannabisproject.ca/methods/). Weights were applied to the original cross-sectional datasets and rescaled to the sample size for Canada, US "legal" states and US "illegal" states. Estimates are weighted unless otherwise specified.

Table 3. Sample characteristics, past 12-month consumers in the International Cannabis Policy Study 2018–2020 (n = 38,448).

	CANADA			US "LEGAL" STATES			US "ILEGAL" STATES		
	2018 (pre-legalization)	2019	2020	2018	2019	2020	2018	2019	2020
	(n = 2,743)	(n = 5,315)	(n = 5,326)	(n = 2,502)	(n = 7,812)	(n = 5,959)	(n = 2,297)	(n = 3,122)	(n = 3,371)
Sex									
Female	45.5%	45.8%	46.9%	46.0%	47.3%	48.0%	43.1%	45.4%	46.6%
Male	54.5%	54.2%	53.1%	54.0%	52.7%	52.0%	56.9%	54.6%	53.4%
Age group (years)									
16–25	20.5%	19.4%	18.1%	19.3%	21.1%	17.7%	22.9%	21.5%	21.3%
26–35	29.1%	28.3%	28.2%	29.3%	27.9%	29.0%	27.8%	28.2%	26.5%
36–45	20.4%	21.0%	21.4%	17.3%	20.4%	22.3%	17.8%	20.8%	21.8%
46–55	16.1%	17.3%	17.2%	18.1%	16.6%	16.5%	18.8%	16.6%	17.3%
56–65	13.9%	14.0%	15.1%	16.0%	14.0%	14.5%	12.8%	12.8%	13.1%
Ethnicity									
White	80.4%	75.1%	75.9%	79.8%	77.8%	77.6%	74.5%	72.9%	74.0%
Other/Mixed/Unstated	19.6%	24.9%	24.1%	20.2%	22.2%	22.3%	25.5%	27.1%	26.0%
Highest education level									
Less than high school/Unstated	18.3%	16.4%	15.1%	10.7%	5.9%	6.4%	15.3%	12.3%	9.8%
High school diploma	28.1%	27.9%	29.4%	18.7%	23.1%	23.3%	19.8%	23.9%	27.5%
Some college/technical training	35.1%	34.3%	33.7%	46.0%	45.2%	41.9%	42.7%	39.2%	39.9%
Bachelor's degree or higher	18.5%	21.4%	21.9%	24.7%	25.8%	28.3%	22.2%	24.6%	22.9%
Income adequacy (difficulty making ends meet)									
Unstated	2.1%	2.6%	2.9%	1.0%	2.7%	2.1%	1.1%	2.1%	2.6%
Very difficult	9.2%	10.6%	9.0%	9.1%	11.0%	10.2%	9.0%	9.8%	11.9%
Difficult	22.4%	24.7%	20.7%	20.4%	24.6%	21.1%	23.0%	23.5%	21.3%
Neither easy nor difficult	36.1%	33.8%	36.4%	34.3%	33.5%	34.9%	30.4%	32.5%	33.4%
Easy	19.0%	18.7%	21.7%	22.1%	18.1%	19.2%	22.2%	19.7%	18.4%
Very easy	11.2%	9.5%	9.4%	13.2%	10.2%	12.4%	14.4%	12.4%	12.5%
Survey device type									
Smartphone*	0%	47.8%	49.2%	0%	57.7%	59.1%	0%	56.8%	59.6%
Tablet	8.2%	7.9%	4.6%	10.8%	4.7%	3.6%	7.2%	4.2%	4.1%
Computer	91.8%	44.3%	46.2%	89.2%	37.6%	37.3%	92.8%	39.0%	36.4%
Cannabis source									
Legal store/website	11.9%	47.8%	57.1%	52.5%	58.5%	61.6%	5.8%	7.2%	8.4%
Other/Illegal/Unstated	88.1%	52.2%	42.9%	47.4%	41.5%	38.4%	94.2%	92.8%	91.6%
Cannabis use frequency									
Less than monthly	31.4%	32.3%	30.1%	27.4%	25.9%	23.4%	29.2%	26.6%	24.5%
Monthly	17.7%	19.8%	18.7%	20.0%	16.3%	19.4%	22.1%	20.0%	18.9%
Weekly	18.5%	16.0%	16.7%	19.4%	16.0%	17.7%	17.3%	15.4%	16.0%
Daily or almost daily	32.4%	31.9%	34.5%	33.3%	41.8%	39.6%	31.4%	37.9%	40.7%
Noticing health warnings on cannabis products									
Yes	10.3%	28.3%	31.3%	27.1%	28.1%	29.4%	11.3%	13.2%	16.4%
No	60.5%	46.3%	41.9%	50.3%	49.1%	46.4%	57.9%	61.5%	53.4%
Not applicable – I haven't seen any cannabis products or packages	24.2%	15.2%	14.2%	15.3%	12.5%	13.9%	26.5%	20.2%	23.7%
Don't know	5.0%	10.1%	12.6%	7.3%	10.3%	10.3%	4.4%	5.1%	6.6%

*Survey was not offered in smartphone format in 2018 (Wave 1).

Separate binary logistic regression models were used to test differences for five primary outcomes:

1. Differences in <u>free recall of any health warning messages</u> between Canada, US legal and US illegal states over time (0 = did not recall any valid health warnings, 1 = recalled ≥1 cannabis health warning). Two-way interactions between jurisdiction and survey wave were tested in a subsequent step.
2. Differences in <u>free recall of individual health warnings</u> between jurisdictions in which the warning was mandated versus jurisdictions in which the warning was not mandated to appear on packages.
3. Differences in <u>recognition of any health warning messages</u> between Canada, US legal and US illegal states over time (0 = did not recognize any valid health warnings, 1 = recognized ≥1 cannabis health warning).
4. Differences in <u>recognition of individual health warnings between jurisdictions</u> in which the warning was

mandated versus jurisdictions in which the warning was not mandated to appear on packages.
5. Differences in the odds of recognizing the false (control) warning on stroke between Canada, US legal and US illegal states.

Models were adjusted for cannabis purchase source, cannabis use frequency, age group, sex, education, ethnicity, income adequacy, and survey device. Adjusted odds ratios (AORs) and 95% confidence intervals are reported. Analyses were conducted using survey procedures in SAS Studio v.9.4.

Results

Table 3 shows the sample characteristics in each jurisdiction as well as reported noticing of cannabis health warning labels in the three survey years. Approximately half of respondents were female, and the majority identified as

White and had at least some college education. Table 3 also show changes in noticing warnings between 2018 and 2019, published elsewhere (Goodman & Hammond, 2021a). Briefly, respondents in Canada showed a greater increase in noticing warnings between 2018 and 2019—before and after non-medical cannabis legalization in Canada, compared to respondents in US "illegal" states and "legal" states.

Free recall of health warning messages

Table 4 shows the content of freely recalled health warning messages by time and jurisdiction. In 2020, the five most common messages recalled among Canadians were all mandated on Canadian cannabis products: (1) driving/operating machinery; (2) addiction/dependence; (3) adult use/keep out of reach of children; (4) psychosis/schizophrenia; and (5) smoke/lung health. In US "legal" states, the top five messages recalled in 2020 were (1) driving/operating machinery; (2) adult use/keep out of reach of children; (3) pregnancy/breastfeeding; (4) addiction/dependence; and a (5) generic statement of caution or other warning; the first four are all mandated in at least some US states, several of which also include a generic statement of caution.

Free recall of at least 1 health warning

Table 5 shows the proportion of consumers who freely recalled at least one health warning, as well as the mean number of messages recalled, by survey wave and jurisdiction. Overall, 24.2% ($n = 9,307$) of consumers reported seeing a health warning on a cannabis product. Approximately half (51.2%, $n = 4,769$) of these respondents identified at least one "valid" message when asked to describe the warning they had seen, accounting for 12.4% of consumers.

Results of a logistic regression indicated significant main effects of jurisdiction ($F(2,36034)=7.04$, $p < 0.001$), cannabis purchase source ($F(1,36035)=579.67$, $p < 0.001$) and cannabis use frequency ($F(3,36033)=46.84$, $p < 0.001$), but no main effect of survey wave ($p = 0.339$) on odds of freely recalling at least one health warning. Consumers in US "legal" states (15.9%; AOR = 1.32, 1.14–1.53, $p < 0.001$) and Canada (12.2%; AOR = 1.24, 1.08–1.43, $p = 0.003$) were significantly more likely to recall at least one health warning compared to consumers in US "illegal" states (6.2%), with no difference between US "legal" states and Canada ($p = 0.203$). Consumers who purchased their cannabis from a legal store/website (21.5%) were significantly more likely to freely recall a warning compared to those who had obtained cannabis from another source (5.8%; AOR = 3.74, 3.36–4.17, $p < 0.001$). Monthly (11.5%; AOR = 1.40, 1.21–1.62, $p < 0.001$), weekly (12.8%; AOR = 1.46, 1.26–1.69, $p < 0.001$) and daily/almost daily consumers (16.7%; AOR = 2.02, 1.79–2.28, $p < 0.001$) were significantly more likely to recall a warning compared to less than monthly consumers (7.1%). There were also significant main effects of all tested sociodemographic covariates ($p \leq 0.01$ for all) except ethnicity ($p = 0.381$; data not shown).

In a subsequent step, a significant two-way interaction between jurisdiction and survey wave was observed ($F(4,36032)=5.99$, $p < 0.001$). Among consumers in Canada, free recall increased from 2018 (pre-legalization) to 2019 (1-year post-legalization) to a greater extent than among consumers in US "legal" states AOR = 1.93, 1.39–2.68, $p < 0.001$) or US "illegal" states (AOR = 1.80, 1.77–2.75, $p = 0.007$), with no difference between US "legal" and "illegal" states ($p = 0.718$). Among consumers in Canada, free recall also increased from 2018 (pre-legalization) to 2020 (2-years post-legalization) to a greater extent than among consumers in US "legal" states AOR = 2.12, 1.51–2.98), $p < 0.001$), with no difference between Canada and US "illegal" states ($p = 0.118$). Among consumers in US "illegal" states, free recall also increased from 2018 to 2020 to a greater extent than among consumers in US "legal" states (AOR = 2.23, 1.05–2.23, $p = 0.027$).

Association between free recall and mandated messaging

An analysis was conducted to examined free recall of individual health warnings between jurisdictions in which the warning was mandated versus jurisdictions in which the warning was not mandated to appear on packages. Virtually all warning messages were significantly more likely to be freely recalled by consumers living in jurisdictions where that warning was mandated: adult use only/keep away from children (4.9% vs. 1.6%; AOR = 2.08, 1.76–2.47, $p < 0.001$); driving/operating machinery (4.7% vs. 1.3%; AOR = 1.79, 1.40–2.28, $p < 0.001$); addiction/dependence/habit-forming (4.0% vs. 0.7%; AOR = 5.59, 4.40–7.11, $p < 0.001$); cancer (3.6% vs. 0.6%; AOR = 4.96, 3.72–6.61, $p < 0.001$); pregnancy/breastfeeding (2.9% vs. 1.2%; AOR = 1.46, 1.15–1.87, $p = 0.002$); smoke/lung health (1.4% vs. 0.7%; AOR = 1.18–2.32, $p = 0.004$); adolescent risk/brain development (1.0% vs. 0.2%; AOR = 6.07, 3.58–10.28, $p < 0.001$); anxiety, memory and concentration (0.6% vs. 0.3%; AOR = 3.60, 1.55–8.36, $p = 0.003$); delayed effects of edibles (0.3% vs. 0.1%; AOR = 2.32, 1.12–4.81, $p = 0.024$); and mental health, including depression, anxiety, psychosis or schizophrenia (0.3% vs. 0.03%; AOR = 8.82, 3.87–20.09, $p < 0.001$). There was no effect of jurisdiction on free recall of the warning on mixing cannabis with alcohol/drugs (0.2% vs. 0.1%; $p = 0.635$). Consumers who purchased cannabis from a legal store/website were significantly more likely to freely recall all warning messages (all $p < 0.05$). For 6 of the 11 warnings (pregnancy/breastfeeding; driving/machinery; edibles; adult use; addiction; cancer), there were also significant effects of cannabis use frequency (all $p < 0.001$) whereby more frequent consumers tended to be more likely to freely recall messages compared to less than monthly consumers.

Message recognition

Figure 1 shows the percentage of respondents in each jurisdiction who recognized each of 11 health warning messages

Table 4. Health warning messages recalled by past 12-month cannabis consumers, by jurisdiction (%, n).

Specific warning messages freely recalled	Total (n = 38,448)	Canada			US "LEGAL" States			US "ILLEGAL" States		
		2018 (pre-legalization) (n = 2,743)	2019 (n = 5,315)	2020 (n = 5,326)	2018 (n = 2,502)	2019 (n = 7,812)	2020 (n = 5,959)	2018 (n = 2,297)	2018 (n = 3,122)	2018 (n = 3,371)
Cannabis and impaired driving or operating machinery	3.6%	1.7%	3.7%	4.1%	5.0%	5.4%	4.7%	1.2%	1.1%	1.4%
Contains THC/cannabis, adult use only, keep out of reach of children/pets	2.9%	1.3%	2.3%	1.9%	5.0%	4.9%	4.6%	0.9%	0.7%	1.3%
Addiction/dependence or social, health or work problems	2.0%	0.7%	3.6%	3.6%	2.8%	1.6%	1.8%	0.7%	0.6%	0.8%
Pregnancy, breastfeeding, may harm infant	2.3%	0.6%	2.3%	0.9%	5.1%	4.6%	2.2%	0.7%	1.1%	0.7%
Generic statement of caution, nonspecific reference to impairment or intoxication, other health warning	2.3%	1.5%	2.0%	1.4%	4.6%	3.6%	1.7%	2.5%	1.5%	1.4%
Cannabis smoke may harm lungs/breathing/respiratory health	1.1%	0.3%	1.3%	1.5%	1.5%	1.1%	1.0%	0.7%	0.6%	0.9%
Cannabis causes cancer (other than lung cancer)**	1.1%	0.1%	0.4%	0.6%	2.3%	2.1%	1.9%	0.3%	0.5%	1.1%
Start low, go slow, use in moderation, consume responsibly, high THC/potency/dosage/serving size	0.6%	0.7%	0.6%	0.7%	0.3%	0.8%	0.7%	0.4%	0.6%	0.2%
Risk of psychosis and schizophrenia, delusions or hallucinations	0.5%	0.1%	1.5%	1.6%	0.1%	0.1%	<0.1%	<0.1%	0.0%	0.1%
Adolescents are at greater risk of harms from cannabis, brain development	0.4%	0.3%	0.9%	1.1%	<0.1%	0.2%	0.2%	0.1%	<0.1%	0.2%
Cannabis/high THC and anxiety, memory and concentration*	0.3%	0.1%	0.4%	0.6%	0.6%	0.3%	0.2%	0.0%	0.1%	0.1%
Edibles and delayed or long-lasting effects*	0.2%	<0.1%	0.1%	0.4%	0.3%	0.2%	0.2%	0.1%	0.1%	0.2%
Negative impact on mental health, depression*	0.1%	<0.1%	0.4%	0.3%	0.0%	0.1%	<0.1%	0.1%	0.1%	0.0%
Vaping-related warnings	0.1%	0.0%	0.1%	<0.1%	0.0%	0.4%	0.1%	0.0%	0.2%	0.1%
Cannabis negatively impacts cardiovascular health	0.1%	0.2%	0.1%	0.1%	0.0%	0.2%	0.2%	<0.1%	<0.1%	0.2%
Cannabis causes lung cancer	0.1%	<0.1%	0.2%	0.3%	<0.1%	0.2%	0.1%	0.0%	0.1%	0.2%
Second-hand cannabis smoke/use around others	0.1%	0.1%	0.1%	0.1%	0.2%	0.3%	<0.1%	0.1%	<0.1%	0.1%
Cannabis causes dizziness	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	<0.1%	0.1%
Do not mix alcohol and cannabis†	0.1%	0.0%	0.1%	0.2%	0.1%	0.1%	0.1%	<0.1%	0.0%	0.0%
Contains CBD, CBD level	<0.1%	0.1%	<0.1%	0.0%	<0.1%	<0.1%	<0.1%	0.0%	0.0%	<0.1%

Grey shading indicates a mandatory warning. Note that for US "legal" states, shading indicates that the warning was mandated in *at least one* state.
*Lighter shading indicates that the warning became effective in Canada on Oct 17, 2019 (two weeks before end of 2019 study period). Source: Government of Canada (2019a).
**Note that the Proposition 65 warning about cancer and reproductive toxicity became mandatory in Jan 2021, after a 1-year phase in period starting in 2020. For more information, please visit: https://www. p65warnings.ca.gov/fact-sheets/cannabis-marijuana-smoke.

Table 5. Percentage and mean number of health warning messages freely recalled by past 12-month cannabis consumers, by jurisdiction (n = 38,448).

Jurisdiction	Freely recalled ≥1 health warning message* % (n)		Number of health warning messages freely recalled Mean (SD)	
	PAST 12-MONTH CONSUMERS (n = 38,448)	PAST 12-MONTH CONSUMERS WHO PURCHASED CANNABIS LEGALLY (n = 16,097)	PAST 12-MONTH CONSUMERS (n = 38,448)	PAST 12-MONTH CONSUMERS WHO PURCHASED CANNABIS LEGALLY (n = 16,097)
Canada				
2018 (pre-legalization, n = 2,743)	5.0% (137)	11.0% (36)	0.11 (0.58)	0.25 (0.75)
2019 (n = 5,315)	13.0% (690)	21.0% (534)	0.26 (0.78)	0.40 (0.88)
2020 (n = 5,326)	15.0% (801)	21.3% (649)	0.28 (0.79)	0.40 (0.90)
US "legal" states				
2018 (n = 2,502)	15.7% (393)	24.3% (319)	0.38 (1.04)	0.59 (1.24)
2019 (n = 7,812)	16.1% (1,256)	22.1% (1,010)	0.33 (0.89)	0.45 (0.99)
2020 (n = 5,959)	15.8% (942)	21.3% (782)	0.35 (0.89)	0.44 (0.96)
US "illegal" states				
2018 (n = 2,297)	5.3% (122)	22.9% (30)	0.12 (0.59)	0.62 (1.35)
2019 (n = 3,122)	5.5% (171)	15.7% (35)	0.13 (0.53)	0.50 (1.00)
2020 (n = 3,371)	7.5% (254)	23.2% (65)	0.19 (0.67)	0.68 (1.23)

*Respondents who did not notice warnings, and those who noticed warnings but responded "don't know" or "refuse" when asked to indicate message content, provided gibberish/irrelevant responses, or could not recall message content were coded as having recalled zero warning messages. The remaining respondents who entered a response were coded as having recalled health warning messages.

included in the 2020 survey. Across cannabis consumers in the three jurisdictions, recognition of each of the 10 health warning messages (excluding the false stroke item) was higher than free recall of the same message (see Table 4); however, the relative order of the messages recalled was similar between the free recall and recognition tasks. For example, in Canada, driving/machinery and addiction were the two messages most likely to be recalled and recognized.

Results of the regression model indicated a significant effect of jurisdiction on likelihood of recognizing at least one warning message ($F(2,13563)=6.96$, $p=0.001$). Consumers in Canada (37.9%; AOR = 1.31, 1.14–1.52, $p<0.001$) and US "legal" states (39.5%; AOR = 1.25, 1.08–1.45, $p=0.004$) were significantly more likely to recognize at least 1 warning message (excluding the false stroke item) compared to US "illegal" states (26.3%). Consumers who purchased their cannabis from a legal store or website (45.7%) were significantly more likely to recognize at least one warning compared to those who had obtained cannabis from another source (26.9%; AOR = 2.14, 1.89–2.41, $p<0.001$). Monthly (39.4%; AOR = 1.60, 1.37–1.86, $p<0.001$), weekly (39.6%; AOR = 1.57, 1.34–1.85, $p<0.001$) and daily/almost daily consumers (39.1%; AOR = 1.65, 1.44–1.89, $p<0.001$) were significantly more likely to recognize a warning than less than monthly consumers (26.3%). There were also significant main effects of all tested covariates (all $p \leq 0.05$) except survey device ($p=0.108$); data not shown.

Association between recognition and mandated messaging

Similar to the free recall task, virtually all warning messages were significantly more likely to be recognized by respondents living in jurisdictions where that warning was mandated versus jurisdictions where it was not: driving/operating machinery (21.4% vs. 9.9%; AOR = 1.57, 1.32–1.85, $p<0.001$); addiction/habit-forming (12.4% vs. 6.8%; AOR =

1.72, 1.43–2.05, $p<0.001$); adolescents/young adults (10.8% vs. 8.1%; AOR = 1.32, 1.11–1.55, $p=0.001$); smoke/lung health (10.4% vs. 6.3%; AOR = 1.50, 1.25–1.79, $p<0.001$); mental health (9.2% vs. 4.8%; AOR = 2.05, 1.68–2.51, $p<0.001$); memory and concentration (8.8% vs. 6.0%; AOR = 1.48, 1.23–1.79, $p<0.001$); delayed effects of edibles (8.7% vs. 4.7%; AOR = 1.31, 1.03–1.66, $p=0.027$); and cancer (8.2% vs. 3.2%; AOR = 2.57, 1.82–3.63, $p<0.001$). With the exception of the cancer warning ($p=0.146$), consumers who purchased cannabis from a legal store/website were significantly more likely to recognize all warning messages (all $p<0.001$). There was no effect of jurisdiction for the warning on mixing cannabis with alcohol/drugs (10.3% vs. 9.5%) before ($p=0.689$) or after ($p=0.597$) adjustment for cannabis purchase source. Jurisdiction was significant for the warning on pregnancy/breastfeeding (14.2% vs. 9.8%) before ($p<0.001$) but not after ($p=0.258$) adjustment for cannabis purchase source. Finally, with the exception of the warnings on mental health ($p=0.135$) and mixing cannabis with alcohol/drugs ($p=0.307$), there were also significant effects of cannabis use frequency in all models (all $p<0.05$), whereby more frequent consumers tended to be more likely to recognize warning messages than less than monthly consumers. Finally, results of the regression model testing recognition of the stroke warning—which was not mandated anywhere and served as a "false" control—indicated no difference across the three jurisdictions ($p=0.309$).

Discussion

Study findings indicate greater awareness of cannabis health effects among consumers living in jurisdictions where warning labels are mandated on cannabis products: consumers living in Canada and US states with legal adult-use cannabis sales were more likely to recall specific health effects displayed in warnings. Most notably, free recall of warnings significantly increased in Canada the year following federal legalization of
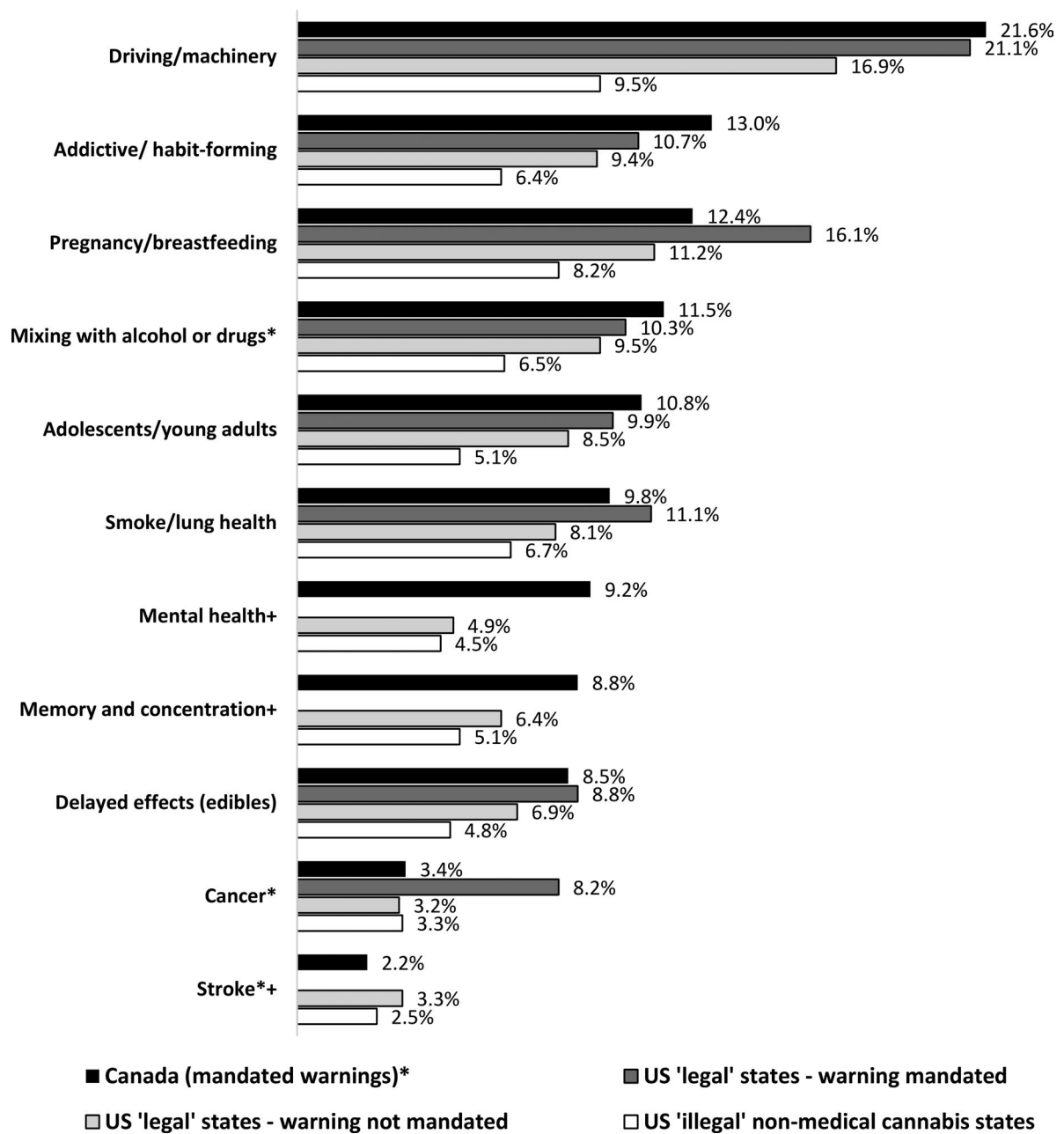
Figure 1. Recognition of health warning messages on cannabis packages among past 12-month cannabis consumers in 2020, by jurisdiction ($n = 14{,}656$). Figure shows percent responding "yes" to each item when asked, "In the past 12 months, have you seen health warnings on marijuana products or packages related to any of the following health effects?" *Asterisk indicates warning was not mandated in Canada (Mixing with alcohol/drugs, Cancer, Stroke). + Cross symbol indicates warning was not mandated in any US "legal" states (Memory and concentration, Mental health, Stroke). Note that stroke was included as a false control item and was not mandated in any jurisdiction.

non-medical cannabis, and increased three-fold by 24 months after legalization: from 5.0% in 2018 to 15.0% in 2020. The increased recall between may reflect greater transition to the legal market and, by extension, greater exposure to the mandated warnings on legal products. Notably, the types of cannabis products available from legal retail sources also increased during this period: dried flower and some orally-ingested oils were available from legal stores since October 2018; however, edibles, vaping products, "solid concentrates," and other products were unavailable until January 2020.

In contrast to the increases in message recall among Canadian consumers, there was no significant difference in recall of warnings in US "legal" states between 2018 and 2020. Although some states have only recently established legal markets, others such as Washington and Oregon have had a legal market for several years. As such, it is unsurprising that the recall of warnings among cannabis consumers was fairly stable in US "legal" states as a whole, consistent with previous findings on noticing of health warnings (Goodman & Hammond, 2021a).

The findings demonstrate a high level of specificity in terms of the individual health effects mandated in warnings and recall/recognition of these effects. In almost all cases, consumers were more likely to freely recall or recognize a specific health effect if they lived in a jurisdiction where it was mandated to be displayed on pack warnings. For example, Canadian consumers had higher odds of recall and recognition for warnings present in Canada only (e.g., adolescent brain development; cognitive and mental health effects of high-THC products). The lack of difference across jurisdictions in recognition of a false warning on stroke—which does not appear on warning labels in any jurisdiction—also suggests that consumer awareness is sensitive to the specific content and health effects displayed in warnings, and not simply a product of social desirability bias. The findings are broadly consistent with previous results on health knowledge from the same study: several health warnings that were commonly recalled (e.g., impaired driving, pregnancy, and addiction) were those with the highest level of agreement in terms of health knowledge (Goodman & Hammond, 2021b).

Specific warning messages were also more commonly recalled by respondents residing in US states with legal cannabis markets. For example, higher odds of recalling and recognizing the warning that cannabis causes cancer were observed among Californian consumers. This is likely due to California's mandated *Proposition 65* label indicating that cannabis smoke and THC are known to cause cancer (Government of California, 2020); other US states and Canada do not mandate a cancer warning. Similarly, more consumers in US "legal" states freely recalled warnings indicating that a product "contains THC/adult use only/keep away from children," likely because this language is mandatory in the majority of states with legal retail sales, whereas this warning does not exist in Canada. Certain other warnings (e.g., pregnancy/breastfeeding, driving/machinery) were more commonly recalled in US "legal" states than Canada, despite both jurisdictions mandating these warnings. While the reason for this is unknown, one might speculate that Canadian consumers who had seen rotating warning messages on cannabis products had several other messages to draw from in their memories when completing the free recall task. In contrast, along with the adult use only warning, pregnancy/breastfeeding and driving/machinery are among the most common warnings across US "legal" states, and therefore may be more commonly recalled.

Despite the substantial increase in free recall in Canada following cannabis legalization, only 15% of Canadian past 12-month cannabis consumers recalled a warning in 2020. The level of recall observed in the current study is markedly lower than that for health warnings on other products, such as tobacco. This difference may reflect the relative novelty of legal cannabis markets and mandated warnings, as well as lower levels of perceived risk among cannabis consumers relative to tobacco smokers (Hammond, 2011). The lower rates of recall may also reflect low engagement with open-ended questions in online surveys. Indeed, recognition rates were higher than free recall, consistent with research indicating that measures of free recall tend to have lower responses compared to recognition tasks (Freund et al., 1969; Stapel, 1998). Notably, both methods produced similar patterns of findings, both with respect to differences between jurisdictions, as well as the relative ordering of specific health effects that were identified by consumers. More generally, future research should examine the salience of specific health warning messages, particularly for lesser-known health effects of cannabis use.

Finally, consumers who purchased products from legal stores/websites had higher levels of recall and recognition of health warnings. This is consistent with results from a previous study indicating that respondents who obtained cannabis from legal sources were more likely to notice cannabis health warnings overall, as were frequent cannabis consumers (Goodman & Hammond, 2021a). According to national research, as of the 2020 survey date, approximately half of Canadian consumers reported purchasing cannabis from legal sources (Government of Canada, 2020). Awareness of warnings would be expected to increase over time as a greater number of consumers transition to legal retail sources.

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 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 Hispanic ethnicity. 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 16–65, 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 non-probability samples (Fahimi et al., 2018), and may be partly due 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). Regarding warning labels, some US states that have not legalized non-medical cannabis nevertheless require warnings on medical cannabis products. However, free recall tended to be lower in US "illegal" states, demonstrating that exposure to these warnings is likely much lower than exposure to mandatory warnings on non-medical products, which are geared toward the general public. In addition, certain US "legal" states only legalized non-medical cannabis in 2019 or 2020; therefore, not all "legal" states would have been exposed to the warnings listed in Table 2 for the entire study period. However, this was accounted for in models testing recall and recognition of specific warnings. Differences between jurisdictions could

also be due to other potentially confounding factors. Multiple data waves enhance natural experimental designs, as they help to characterize and account for different preexisting trends between countries (Shadish et al., 2002). The use of policy-specific measures also helps attribute differences to a specific policy (International Agency for Research on Cancer, 2008). In the current study, the primary outcome measures are explicitly related to noticing warnings on cannabis packages, rather than more general or "distal" outcomes such as changes in knowledge or attitudes toward cannabis products. The current observational findings are also consistent with experimental findings indicating that the design of Canadian health warnings are associated with greater recall. Finally, recall of warnings may have been influenced by the mandated warnings for other consumer products, such as alcohol warnings related to pregnancy and driving/operating machinery, although recall of these warnings is typically very low (Hassan & Shiu, 2018). No alcohol warnings on products are mandated in Canada.

Conclusions

The current study represents the most comprehensive "real world" assessment of cannabis health warnings to date. The findings suggest that legalization provides an opportunity to communicate with cannabis consumers through the use of mandated warnings, although to a lesser extent for consumers who continue to source their products through illicit channels. Future research should examine whether more comprehensive warnings—such as those mandated in Canada—are associated with greater impact over time, including downstream changes in health knowledge.

Notes

1. The following messages tested in the recognition task aligned with the Canadian mandatory health warnings introduced in 2018/2019: pregnancy or breastfeeding; driving or operating machinery; cannabis smoke/lung health; adolescents/young adults; mental health (e.g., anxiety or depression); addictive/habit-forming; memory and concentration; and delayed effects of edibles. The following messages aligned with warnings present in at least one US 'legal' state during the study period: driving/operating machinery; pregnancy/breastfeeding; addictive/habit-forming; cannabis smoke; delayed effects of edibles; mixing with alcohol/drugs; and cancer.
2. Note that while home growth is authorized in some jurisdictions, 'grew my own' was classified as 'Illegal/Other/Unstated' because it is not a possible source of exposure to mandated health warnings. Likewise, family member/friend was coded as 'Illegal/Other/Unstated' because no information was available on whether the family member/friend sourced their cannabis from a legal store/website and/or whether packaging was retained.

Data availability

The datasets associated with this research are available from the corresponding author upon reasonable request.

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