

# BMJ Open Adverse outcomes of cannabis use in Canada, before and after legalisation of non-medical cannabis: cross-sectional analysis of the International Cannabis Policy Study

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## ABSTRACT

**Objectives** To date, there is little evidence on the extent to which cannabis legalisation affects the prevalence of adverse events from cannabis at the population level. The current study examined trends in the prevalence of adverse events among people who consumed cannabis before and after Canada's legalisation of recreational cannabis.

**Design** Data come from the first four survey waves of the International Cannabis Policy Study, which were conducted online annually immediately prior to non-medical cannabis legalisation in Canada in October 2018, and in the three following years (2019–2021).

**Participants** The current analysis included 18 285 Canadian respondents aged 16–65 who reported cannabis use in the past 12 months.

**Outcome measures** Primary outcomes included types of adverse events experienced from cannabis use, medical help-seeking and the types of products used. Weighted logistic regression models examined differences in help-seeking, emergency room usage and the experience of cannabinoid hyperemesis syndrome across survey years.

**Results** Approximately one-third of people who consume cannabis reported experiencing at least one adverse event within the past 12 months, including 5% of consumers who sought medical help for an adverse event, most commonly for panic attacks, feeling faint/dizzy/passing out, heart/blood pressure problems and nausea/vomiting. The prevalence of seeking help and the types of adverse events were similar before (2018) and after legalisation (2019–2021); however, the proportion of consumers seeking help from emergency rooms increased postlegalisation ( $F=2.77$ ,  $p=0.041$ ). Adverse events were associated with various product types, with dried flower and oral oils accounting for the largest proportion of events. Help-seeking associated with cannabis edibles significantly decreased after legalisation ( $p=0.001$ ).

**Conclusions** Substantial proportions of people who consume cannabis report adverse events, suggesting widespread difficulty in 'dosing'. Few changes were observed in the prevalence of adverse events reported by consumers since legalisation; however, the location of medical help-seeking and associated products used have changed postlegalisation.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The national sample and large sample size of 18 285 people who use cannabis, including data collected before and after legalisation of non-medical cannabis in Canada are strengths.
- ⇒ The population-level sample provides estimates of the prevalence of adverse outcomes from using cannabis, including detail on the types of products used and the types of medical help that were sought.
- ⇒ All data used in the study were self-reported, which is subject to recall and social desirability bias.
- ⇒ The repeat cross-sectional study design did not allow for the assessment of individual-level changes in adverse events over time.
- ⇒ A few of the questions were not asked in each survey year, which limited the ability to track changes over time for some outcomes.

## BACKGROUND

Cannabis is one of the most widely used recreational drugs globally.<sup>1</sup> In 2016, it was estimated that the worldwide population of people who consume cannabis surpassed 192 million individuals.<sup>1</sup> In most countries, cannabis remains a prohibited substance; however, an increasing number of countries are adopting more permissive laws for cannabis, including Canada, which legalised non-medical (or 'recreational') cannabis in October 2018.<sup>1</sup>

Cannabis has therapeutic effects, which are typically associated with 'medical' cannabis use for managing conditions such as pain, multiple sclerosis and other chronic conditions.<sup>1</sup> Cannabis also has a range of negative health effects. Early initiation and long-term cannabis use increases the risk of dependence and poor mental health outcomes, and is associated with an elevated risk of some cardiovascular and respiratory diseases, with suggestive evidence of a link with testicular



cancer.<sup>2,3</sup> Heavy, long-term cannabis use is also linked to the development of cannabinoid hyperemesis syndrome, which consists of severe, repetitive vomiting occurring episodically from cannabis use.<sup>4,5</sup> There are limited data regarding the prevalence of cannabinoid hyperemesis syndrome, often due to inconsistent criteria for diagnosis, resulting in a wide range of estimates, including up to one-third of people who consume cannabis daily.<sup>4,5</sup>

In addition to long-term chronic health effects, cannabis use can also have acute health effects. The vast majority of cannabis-related mortality is associated with injuries from impaired driving and, to a lesser extent, impairment in the workplace.<sup>3,6</sup> However, cannabis does not lead to ‘overdose’ deaths, and has only been identified as a contributing factor to a very small number of deaths associated with cannabinoid hyperemesis and cardiovascular events.<sup>7</sup> With the notable exception of the e-cigarette or vaping product-use-associated lung injury (EVALI) outbreak in 2019—in which tetrahydrocannabinol (THC) vaping liquids included highly toxic constituents, resulting in approximately 2800 hospitalisations and 68 deaths—most adverse events from cannabis are non-fatal and short-term in duration.<sup>8,9</sup> Overconsumption of cannabis can lead to a range of short-term adverse events, including heart palpitations, panic, paranoia and psychosis.<sup>1,10</sup> Adverse events also result from ‘accidental’ cannabis consumption, which produces similar outcomes to overconsumption, but disproportionately affects children.<sup>10</sup>

Adverse events from cannabis result in a considerable burden on the healthcare system. In 2011, more than 455 000 emergency department visits in the USA were related to cannabis use.<sup>11</sup> Several studies have examined whether more permissive cannabis policies, including the legalisation of non-medical cannabis, are associated with an increase in adverse events from cannabis. Seven studies have examined changes in hospital admissions before and after the federal legalisation of non-medical cannabis in Canada in 2018.<sup>12–18</sup> Prior to cannabis legalisation, there was a gradual increase in emergency department visits in Alberta and Ontario, which was accelerated after legalisation.<sup>15,16</sup> Other studies have noted increases in paediatric hospitalisations due to unintentional cannabis poisonings,<sup>17</sup> with mixed findings on the incidence of substance-related emergency department visits between 2016 and 2019 by individuals aged 12–24 years.<sup>18</sup> Several studies conducted in the USA have also compared differences in cannabis-related hospitalisations based on state-level medical and non-medical cannabis legalisation, with mixed findings. One study found decreases in hospitalisations and emergency department visits shortly after the legalisation of non-medical cannabis in Colorado—one of the first US jurisdictions to legalise non-medical cannabis,<sup>19</sup> whereas other studies have found greater increases in states that have legalised non-medical cannabis in cannabis-related hospitalisations among adolescents.<sup>20</sup> Overall, it is unclear whether the legalisation of non-medical

cannabis is associated with an increase in adverse outcomes related to cannabis use.

To date, there is little evidence on the extent to which the risk of adverse events from cannabis is associated with the type of cannabis product used. Over the past decade, cannabis products have increased in both diversity and potency.<sup>7</sup> These include smoking dried cannabis or its concentrates, vaping aerosolising cannabis from liquid extracts, and edibles infused with cannabis.<sup>7</sup> Edibles are most commonly associated with overconsumption due to the longer time to onset and highly variable THC content, with few sensory cues to guide consumption.<sup>21</sup> Edibles are also the product form most commonly associated with accidental ingestion due to the inherent appeal of chocolate and candy edibles among children.<sup>10,17,21</sup> However, there is little data on the proportion of adverse events attributable to different types of cannabis products, mainly because this data is rarely collected with administrative healthcare data, such as hospitalisations.

Overall, there is a need for population-based assessments of cannabis-related adverse events, including greater detail on the prevalence of adverse events, the settings in which consumers seek medical help for adverse events, and whether certain types of products are associated with an increased risk of experiencing an adverse event. There is also a need to examine the extent to which the prevalence of adverse events changes following the legalisation of non-medical cannabis. The current study sought to examine the rates of adverse cannabis-related events in Canada since 2018, including the proportion of consumers who experience adverse events, the types of events that are most prevalent, and the products most associated with them. These trends were examined over time and across sociodemographic groups to examine the primary hypothesis that people who use cannabis will report a similar likelihood of adverse outcomes and seeking medical help immediately before cannabis legalisation compared with the 3 years postlegalisation. Secondary hypotheses were also assessed, including a higher likelihood of medical help-seeking for adverse events among ‘novel’ consumers and consumers using higher THC products.

## METHODS

### Study design

The data used in this study are from annual waves of the repeated cross-sectional International Cannabis Policy Study (ICPS), conducted in Canada in 2018, 2019, 2020 and 2021.<sup>22–25</sup> Data were collected from respondents aged 16–65 via self-completed web-based surveys conducted in August–October 2018, September–October 2019, September–November 2020 and September–November 2021. 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 province of residence. All participants younger

than 18 were recruited through their parents, who provided consent as did the survey respondent. On completion, respondents received 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.<sup>26</sup> The cooperation rate, which was calculated based on AAPOR Cooperation Rate #2 as the percentage of respondents who completed the survey of the eligible respondents who accessed the survey link, was 64.2% in 2018, 62.9% in 2019, 62.0% in 2020 and 60.8% in 2021.<sup>27</sup> Surveys were conducted in English or French in Canada. Median survey time was 20 min in 2018, 25 min in 2019, 21 min in 2020 and 22 min in 2021. The current analysis only includes respondents who had consumed cannabis at least once in the past 12 months that resided in Canada at the time of the survey.

## Measures

The ICPS surveys were developed over a multiyear process, including consultation with international experts in cannabis use, a review of existing surveillance surveys, focus groups conducted with youth and young adults, and cognitive interviewing with cannabis consumers.<sup>28,29</sup> Surveys were completed in English and French, and a full copy of the survey is available at [www.cannabisproject.ca/methods](http://www.cannabisproject.ca/methods).

## Primary outcomes

### Adverse event experienced

People who had used cannabis in the past 12 months were asked, 'In the past 12 months, have you experienced any adverse or negative health effect(s) from marijuana use? Respondents could select 'all that apply' from a precoded checklist of 9 health effects (see online supplemental table 1), as well as a write-in 'other' option. A derived binary variable, 'any adverse event experienced', was created where 1='any adverse event experienced in past 12 months' and 0='none/don't know'. The experience of adverse event(s) was not assessed in the 2018 or 2019 surveys.

### Serious adverse events

Federal cannabis regulations in Canada define a 'serious adverse event' as a: 'noxious and unintended response to a cannabis product that requires in-patient hospitalisation or prolongation of existing hospitalisation, causes congenital malformation, results in persistent or significant disability or incapacity, is life-threatening or results in death'.<sup>30</sup> In the 2020 and 2021 surveys, people who had used cannabis in the past 12 months were asked: 'In the past 12 months, have you experienced any of the following serious adverse effects from marijuana use?' With the response options of 'in-patient hospitalisation (or prolonged existing hospitalisation)', 'persistent or significant disability or incapacity', 'life-threatening reaction', 'none of the above', 'don't know' and 'refuse to answer'. A binary outcome of 'any serious adverse event' was created, where 1='any serious event' and 0='none/'

don't know'. Serious adverse events were not assessed in the 2018 or 2019 surveys.

## Medical help-seeking

Past 12-month consumers were asked to report: 'In the past 12 months, did you seek medical help for any adverse negative health effect(s) caused by using marijuana?' (yes/no/don't know). Analysis of this binary variable coded 1='yes' and 0='no' or 'don't know'. Respondents who reported seeking medical help were asked, 'which negative health effect(s) from marijuana use did you seek medical help for?' using the same precoded checklist and 'other' option described above. Note that, beginning in 2019, the option of 'lung or breathing problems' was added to the checklist.

## Secondary outcomes

### Type of medical help sought

Respondents who reported seeking medical help for an adverse event were asked if they visited an emergency room (ER) ('In the past 12 months, did you go to an emergency department to seek help for any adverse or negative health effect(s) caused by using marijuana?'). An additional question was added to the 2019–2021 surveys, in which respondents who sought out medical help were asked, 'In the past 12 months, did you seek help for any adverse or negative health effect(s) caused by marijuana at any of these other places?', with the response options of 'poison centre', 'doctor or other health professional', 'walk-in clinic', 'telephone health service/helpline', 'addiction support service', 'other (please specify)'. In all cases, 'don't know' responses were categorised with 'no' responses.

### Type of cannabis product associated with the adverse event

Respondents who experienced adverse events from cannabis use in the past 12 months were asked, 'When you experienced the negative health effects, what type or form of marijuana were you using?', with the option to 'select all that apply' from the list of 10 product categories shown in table 1, as well as 'other'. Note that, two of the options—'liquid capsules' and 'oils or liquids for vaping'—were added to the 2019–2021 surveys.

## Cannabinoid hyperemesis syndrome

In the 2019–2021 surveys, people who had used cannabis in the past 12 months were asked, 'Have you ever experienced cannabinoid hyperemesis syndrome (repeated, severe vomiting from marijuana use)?', with the response options of 'yes', 'no', 'don't know'.

## Covariates and potential confounders

### Sociodemographics

Respondents provided demographic information, including age, sex-at-birth, education level, race/ethnicity and perceived income adequacy (how easy/difficult it is for one's family to make ends meet).



**Table 1** Form of cannabis product used during past 12-month adverse event experiences that medical help was sought for, 2018–2021

Product type*	2018 n=123	2019 n=239	2020 n=202	2021 n=249
Dried herb	46.5% (57)	42.3% (101)	43.4% (88)	39.3% (98)
Oil or liquid drops	39.7% (49)	35.0% (84)	20.6% (42)	34.3% (85)
Oil or liquid capsules	NA	34.9% (84)	33.4% (67)	33.6% (84)
Oils or liquids for vaping	NA	22.6% (54)	18.4% (37)	12.4% (31)
Edibles/foods	37.6% (46)	5.9% (14)	4.5% (9)	3.6% (9)
Hash or kief	19.9% (24)	8.4% (20)	18.0% (36)	10.6% (26)
Concentrates	15.1% (19)	8.5% (20)	9.9% (20)	7.6% (19)
Tinctures	9.7% (12)	5.8% (14)	11.7% (24)	6.7% (17)
Drinks	4.7% (6)	7.9% (19)	14.6% (29)	9.4% (23)
Topical ointments	0.8% (1)	4.7% (11)	3.8% (8)	1.1% (3)
Other	0.7% (1)	0.0% (0)	0.0% (0)	0.0% (0)

\*1 'refused' in 2018, 1 'refused' in 2019 and 1 'refused' in 2020.  
NA, not asked.

### Cannabis use frequency

Respondents who reported they had used cannabis in the past 12 months were asked their frequency of cannabis use, with responses categorised as 'daily/near daily', 'weekly', 'monthly' or 'less than monthly'.

### Analysis

A total of 58 045 respondents completed the 2018–2021 Canadian ICPS surveys. A total of 39 617 respondents were excluded because they did not report past 12 month cannabis use. An additional 143 respondents were excluded due to missing data on education level, resulting in a final analytical sample size of 18 285. For all outcomes other than 'medical help-seeking', sample exclusions were based on 'list-wise' deletion.

Poststratification sample weights were constructed based on known population targets. Respondents were classified into age-by-sex-by-province, education and age-by-smoking status groups. Correspondingly grouped population count and proportion estimates were obtained from Statistics Canada.<sup>31 32</sup> A raking algorithm was applied to the cross-sectional analytical sample to compute weights that were calibrated to these groupings. Weights were rescaled to the sample size for each jurisdiction. Estimates are weighted unless otherwise specified.

Descriptive statistics (frequencies, mean/SD) were used to describe the primary outcomes. Three logistic regression models were conducted for three outcomes: (1) medical help-seeking status for adverse events, (2) seeking medical help at an ER, where 0='no/don't know' and 1='yes' for each outcome, as well as (3) cannabinoid hyperemesis syndrome, where 0='no', 1='yes' and 77='don't know'. Regression models were adjusted for cannabis use frequency, age, sex, education level, ethnicity and income adequacy. Adjusted ORs are reported with 95% CIs.  $\chi^2$  tests were used to examine the effect of survey year on the type of cannabis product associated

with adverse events due to the smaller subsample of respondents (ie, only those who sought medical help for an adverse event), which led to model convergence problems when fitting regression models that adjusted for the list of covariates described above. Analyses were conducted by using survey procedures in SAS (SAS V.9.4, SAS Institute).

### Patient and public involvement

Individuals with lived experience with cannabis contributed to the design of the study through focus groups and cognitive interviewing. Study participants are also provided with an opportunity to access study findings through the project website and by directly contacting the principal investigator.

## RESULTS

### Sample characteristics

Table 2 shows the unweighted and weighted sample characteristics for the people who had used cannabis in the past 12 months included in the current analysis. As table 2 shows, people who had used cannabis in the past 12 months included a lower number of females than males, were relatively younger and included more post-secondary educated individuals.

### Adverse events

#### Any adverse event experienced

People who had used cannabis in the past 12 months in 2020 (n=4993) and 2021 (n=5727) were asked to report any adverse events they had experienced from cannabis use in the previous 12 months. Overall, 29% reported experiencing at least one adverse event in 2020, similar to the 30% of consumers who reported at least one adverse event in 2021 (see online supplemental table 1 for full results).

**Table 2** Sample characteristics of people who consumed cannabis in the past 12 months (n=18 285)

	Unweighted n=18 285	Weighted n=18 285
<b>Age</b>		
16–25	16.0% (2927)	18.4% (3358)
26–35	24.2% (4417)	28.5% (5210)
36–45	21.7% (3973)	21.9% (4003)
46–55	17.7% (3230)	16.8% (3071)
56–65	20.4% (3738)	14.5% (2643)
<b>Sex at birth</b>		
Female	58.2% (10 651)	46.3% (8471)
<b>Education level</b>		
Less than high school	8.7% (1584)	15.5% (2832)
High school diploma or equivalent	17.1% (3121)	28.7% (5249)
Some college or technical vocation	44.5% (8128)	34.6% (6332)
Bachelor's degree or higher	29.8% (5452)	21.2% (3872)
<b>Ethnicity</b>		
Black only	2.8% (517)	3.6% (655)
East/South East Asian only	4.6% (847)	4.6% (849)
Indigenous only	3.9% (707)	3.9% (713)
Latino only	1.5% (272)	1.9% (348)
Middle Eastern only	1.1% (210)	1.1% (204)
South Asian only	2.4% (431)	2.8% (507)
White only	77.5% (14 169)	75.5% (13 796)
Mixed/other/unstated	6.2% (1132)	6.6% (1212)
<b>Income adequacy</b>		
Very difficult	9.7% (1771)	9.9% (1813)
Difficult	22.1% (4036)	22.4% (4090)
Neither easy nor difficult	35.2% (6433)	35.1% (6427)
Easy	20.5% (3757)	19.9% (3633)
Very easy	10.5% (1911)	10.0% (1835)
Unstated	2.1% (377)	2.7% (487)
<b>Frequency of cannabis use</b>		
Past 12 months	33.0% (6026)	29.4% (5376)
Monthly	18.8% (3443)	19.2% (3519)
Weekly	16.5% (3022)	16.9% (3082)
Daily/almost daily	31.7% (5794)	34.5% (6309)
<b>Survey wave</b>		
Wave 1–2018	13.1% (2403)	14.1% (2579)
Wave 2–2019	27.5% (5020)	27.3% (4985)
Wave 3–2020	27.2% (4969)	27.3% (4993)
Wave 4–2021	32.2% (5893)	32.3% (5727)

In 2020 and 2021, people who had used cannabis in the past 12 months were also asked to report any serious adverse events that they had experienced from cannabis use in the previous 12 months. Overall, 6% and 7% of consumers in 2020 and 2021 (respectively) reported

experiencing at least one serious adverse event from cannabis (see online supplemental table 1).

### Seeking medical help for an adverse event

Table 3 shows the percentage of people who had used cannabis in the past 12 months that reported seeking medical help in the past 12 months for their experience of adverse events (n=2560 in 2018; n=4937 in 2019; n=4933 in 2020; n=5677 in 2021). As shown in table 3, approximately 5% of people who had used cannabis in the past 12 months sought medical help in each year between 2018 and 2021. Panic reactions and feeling faint, dizzy or passing out were the most commonly reported adverse events across the 4 years, followed by heart or blood pressure problems, hallucinations/psychosis, and nausea and/or vomiting.

In the binary logistic model adjusting for the covariates, there was modest evidence of differences in medical help-seeking across years (F=2.60, p=0.051; see online supplemental table 2 for full model results). No changes were observed in the year before and immediately after legalisation (2018 vs 2019: OR 0.99, 95% CI 0.70 to 1.40, p=0.968); however, there was a moderate decrease in seeking medical help for adverse events in 2020 vs 2019 (OR 0.75, 95% CI 0.58 to 0.98, p=0.034); with no evidence of a change between 2020 and 2021 (OR 1.01, 95% CI 0.78 to 1.32, p=0.918).

Seeking medical help for adverse events also differed by age (F=21.00, p=0.001) and sex-at-birth (F=7.67, p=0.006) in the adjusted binary logistic model; with increased medical help-seeking seen in the younger age cohorts and by males respectively. Differences were also seen for perceived income adequacy (F=5.86, p=0.001) and ethnicity (F=18.35, p=0.001). Particularly, respondents who identified as Black (OR 5.08, 95% CI 3.62 to 7.14, p=0.001), South Asian (OR 4.20, 95% CI 2.87 to 6.15, p=0.001), Middle Eastern (OR 2.86, 95% CI 1.65 to 4.96, p=0.001), Latino (OR 2.26, 95% CI 1.21 to 4.19, p=0.010) and East/South East Asian (OR 2.17, 95% CI 1.47 to 3.22, p=0.001) were more likely to report seeking medical help for adverse events than respondents who identified as White. Seeking medical help for adverse events did not differ by education level in the model (F=1.88, p=0.131).

### Cannabinoid hyperemesis syndrome experience

People who had used cannabis in the past 12 months in 2019 (n=4943), 2020 (n=4952) and 2021 (n=5674) were asked to report their lifetime experience of cannabinoid hyperemesis syndrome. As shown in table 4, approximately 6% reported 'ever' experiencing cannabinoid hyperemesis syndrome in their lifetime in 2019. The prevalence of 'ever' experiencing cannabinoid hyperemesis syndrome decreased to 5% in 2020 (OR 0.79, 95% CI 0.66 to 0.94, p=0.007) and remained at 6% in 2021 (OR 1.11, 95% CI 0.93 to 1.33, p=0.237). The odds of lifetime experience of cannabinoid hyperemesis syndrome also differed by ethnicity (F=4.08, p=0.001): respondents who identified as Black (OR 2.52, 95% CI 1.51 to 4.22,

**Table 3** Medical help-seeking for adverse events from cannabis use among people who consumed cannabis in the past 12 months, 2018–2021

	2018 n=2560	2019 n=4937	2020 n=4933	2021 n=5677
Sought any medical help for health effect*	5.0% (128)	5.5% (272)	4.2% (210)	4.5% (253)
Panic reactions	30.2% (39)	32.1% (87)	30.0% (63)	30.9% (78)
Feeling faint or dizzy or passing out	29.6% (38)	36.5% (99)	35.2% (74)	29.6% (75)
Heart or blood pressure problems	29.5% (38)	28.4% (77)	25.6% (54)	27.9% (71)
Hallucinations/psychosis	27.2% (35)	14.6% (40)	21.7% (46)	12.0% (33)
Nausea and/or vomiting	21.6% (28)	21.2% (58)	22.4% (47)	24.9% (63)
Dissociation/depersonalisation	15.2% (19)	7.1% (19)	13.9% (29)	6.2% (16)
Flashbacks	12.8% (16)	12.3% (34)	11.3% (24)	13.9% (35)
Depression	11.8% (15)	19.0% (52)	25.2% (53)	19.0% (48)
Lung or breathing problems	NA	NA	7.4% (16)	8.2% (21)
Other	7.4% (9)	2.0% (5)	0.4% (1)	1.0% (3)
Source of help among those who sought medical help	n=128	n=272	n=210	n=253
Emergency room†	44.7% (57)	58.4% (159)	59.6% (120)	66.1% (168)
'Any other source of medical help'‡	NA	83.1% (216)	83.6% (172)	88.3% (223)
Doctor or other health professional	NA	40.0% (104)	37.2% (76)	48.1% (122)
Walk-in clinic	NA	33.9% (88)	37.0% (76)	30.6% (77)
Poison centre	NA	21.4% (55)	17.6% (36)	25.8% (65)
Telephone health service/helpline	NA	14.7% (38)	19.9% (41)	21.9% (55)
Addiction support service	NA	8.4% (22)	12.6% (26)	10.6% (27)
Other	NA	0.5% (1)	0.0% (0)	0.0% (0)

\*10 excluded in 2018, 34 excluded in 2019, 41 excluded in 2020 and 37 excluded in 2021 due to 'refused'.

†1 excluded in 2019 and 2 excluded in 2020 due to 'refused'.

‡11 'refused' in 2019, 1 'refused' in 2020 and 1 'refused' in 2021.

NA, not asked.

$p=0.001$ ), Middle Eastern (OR 2.04, 95% CI 1.21 to 3.43,  $p=0.008$ ) and South Asian (OR 2.42, 95% CI 1.42 to 4.12,  $p=0.001$ ) were more likely to report experiencing cannabinoid hyperemesis syndrome compared with those who identified as White. No other sociodemographic differences were observed (see full results in online supplemental table 3).

#### Location of medical help-seeking for adverse events

Table 3 shows the frequency of each location where people who had used cannabis in the past 12 months that experienced adverse events sought medical help (n=128

in 2018; n=272 in 2019; n=210 in 2020; n=253 in 2021). The frequency of ER visits increased across 2018–2021, increasing by approximately 20% from 2018, prelegalisation, to 2021. In the adjusted binary logistic model, there was an overall effect of year for seeking help at the ER ( $F=2.77$ ,  $p=0.041$ ), in which seeking help at an ER was higher in each of 2019, 2020 and 2021 compared with immediately before legalisation in 2018 (see online supplemental table 4). In addition, there were differences in seeking help at ERs by ethnicity ( $F=3.21$ ,  $p=0.002$ ): respondents who identified as Black (OR 3.71, 95% CI 1.82 to 7.55,  $p=0.001$ ), South Asian only (OR 2.29, 95% CI 1.07 to 4.89,  $p=0.033$ ), Indigenous (OR 2.49, 95% CI 1.04 to 5.99,  $p=0.042$ ) and Mixed/other/unstated (OR 2.64, 95% CI 1.27 to 5.50,  $p=0.010$ ) were more likely to seek help at an ER compared with those who identified as White. No other significant sociodemographic differences were observed.

Respondents in 2019, 2020 and 2021 were asked if they sought medical help at several sources other than ERs. As table 3 indicates, seeking medical help from a doctor or other health professional was the most common source of medical help other than the ER. In 2019, 40% of respondents who sought medical help did so from a doctor or

**Table 4** Lifetime cannabis hyperemesis syndrome experience by people who consumed cannabis in the past 12 months, in 2019, 2020 and 2021

	2019 n=4943	2020 n=4952	2021 n=5674
Cannabinoid hyperemesis syndrome*	5.8% (285)	4.6% (230)	5.8% (331)

\*44 excluded in 2019, 28 excluded in 2020 and 38 excluded in 2021 due to 'refused'.

other health professional. This slightly decreased to 37% in 2020, before notably increasing to 48% in 2021. Walk-in clinics and poison centres were the next most common sources of medical help, with approximately 34% and 22% of respondents who sought medical help reporting using them, respectively.

### Cannabis products associated with adverse events

Respondents in 2018 (n=123), 2019 (n=239), 2020 (n=202) and 2021 (n=249) were asked which form of cannabis they were using when they experienced adverse events from cannabis use in the past 12 months. As shown in table 1, dried herb, oil or liquid drops and oil or liquid capsules were the most prevalent forms of cannabis used prior to experiencing adverse events. The use of dried herb during the adverse events decreased by more than 5% between 2018 and 2021 but remained the most commonly reported product type in all years.

Additionally, the frequency in which edibles were used during adverse events greatly decreased by more than 30% postlegalisation. In 2018, prelegalisation, approximately 38% of past 12-month consumers who experienced adverse events were using edibles, which decreased to approximately 6% in 2019, and then to approximately 4% in 2020 and 2021. Online supplemental table 5 shows tests for changes over time. The most notable changes were observed for edibles (F=13.96, p=0.001): compared with 2018, edibles were less likely to be reported for adverse events in 2019 (OR 0.10, 95% CI 0.04 to 0.28, p=0.001), 2020 (OR 0.08, 95% CI 0.03 to 0.20, p=0.001) and 2021 (OR 0.06, 95% CI 0.02 to 0.18, p=0.001).

### DISCUSSION

The current study is among the most comprehensive population-level assessments of the adverse health effects reported by people who had used cannabis in the past 12 months. The experience of adverse events from cannabis use, the study's primary outcome, appears to be relatively common among consumers. This aligns with findings from previous population-based surveys, including one survey of undergraduate university students that found that most of the people who had used cannabis in the past 12 months reported at least one adverse event, including coughing, anxiety and paranoia.<sup>33</sup> Another survey examined the frequency of adverse effects among 2900 adults who consume cannabis across the USA from 2013 to 2018 and observed a range of acute effects, including dry mouth (63%), short-term memory problems (42%) and forgetfulness (37%).<sup>34</sup> The current study is among the first to estimate the prevalence of cannabis hyperemesis syndrome at the population level, as a secondary outcome. Overall, approximately 5%–6% of consumers reported 'ever' experiencing cannabis hyperemesis syndrome. Because this condition is hypothesised to result from chronic cannabis use and often takes years to develop,<sup>45</sup> it may be premature to examine the recent impact of cannabis legalisation. Although there was little

change in the proportion of past 12-month consumers who reported adverse events after legalisation, the prevalence of cannabis use has increased in Canada over this period: according to Canada's national monitoring survey, the prevalence of past 12-month cannabis use increased from 22% in 2018 (prior to legalisation) to 25% over the following 3 years.<sup>35</sup> Therefore, even though the likelihood of a person using cannabis experiencing an adverse event was stable, the number of people using cannabis increased by approximately 14%, such that the overall number of adverse events and use of healthcare services may have increased accordingly at the population level.<sup>35</sup> Data on cannabis hospitalisations, which provide context on the scope of cannabis-related events that require hospitalisations: over the 16-month period between March 2020 and June 2021, there were approximately 25 000 hospitalisations for cannabis-related harms, which would include visits for acute adverse events and other clinical outcomes, such as diagnoses for cannabis use disorder.<sup>36</sup>

People who consumed cannabis were most likely to seek medical help from the ER, which accounted for approximately two-thirds of those who sought medical help as of 2021, followed by visits to a doctor or other medical professional, which accounted for 40% of incidents for which help was sought. Although the proportion of consumers who sought help did not increase since legalisation, ER visits increased by approximately 20 percentage points among those who sought help. The self-reported data from the current study are consistent with administrative healthcare data from various regions in Canada, which indicate an increase in ER visits after cannabis legalisation.<sup>12–18</sup> Likewise, provincial poison centres in the province of Quebec reported three times the number of calls postlegalisation.<sup>37</sup> The increased use of ER and other healthcare services among those who sought medical help may reflect a change in the severity of adverse events that consumers are experiencing or a change in their comfort level in seeking formal medical help due to greater normalisation or comfort disclosing cannabis use following legalisation.<sup>35</sup> In regard to longer-term trends over time, hospitalisations for cannabis increased for most of the decade prior to legalisation in Canada, followed by an attenuation immediately after legalisation in October 2018.<sup>38</sup> Marked increases in cannabis-related hospitalisations were observed in March 2020, possibly due to the onset of the pandemic. Indeed, similar increases in hospitalisations were observed over the same pandemic period for a wide range of other substances, including for alcohol.<sup>39</sup> Additional data in the years after pandemic restrictions were removed in Canada will be critically important to distinguishing between the effects of legalisation vs the COVID-19 pandemic.

Adverse events were associated with a range of product types as another secondary outcome of the study. Although adverse events are widely attributed primarily to edibles in media and anecdotal reports,<sup>10 17 21</sup> dried flower and oral oils were the products most often used





by consumers prior to experiencing adverse events. The proportion of adverse events associated with each product type is roughly consistent with the overall prevalence of use for each product: dried flower remains the dominant product used by Canadian consumers<sup>35 40</sup> and, therefore, accounts for most adverse events. The range of products associated with adverse events suggests that events are not attributable to a single product type or mode of administration; rather, consumers appear to have difficulty identifying and consuming the appropriate dose to avoid overconsumption.<sup>41–43</sup> Edibles were the third most commonly used product associated with adverse events prior to legalisation; however, the proportion of adverse events associated with edibles decreased from 38% in 2018 to 4% in 2021. This decrease in edibles' association with adverse events occurred despite substantial increases in the use of edibles among Canadians who consume cannabis over the same period.<sup>35 40</sup> This apparently contradictory pattern of findings—in which adverse events from edibles fell markedly during the period when the use of edibles increased—may be explained by the way cannabis edibles are regulated in Canada under legalisation. Edibles can have a maximum of 10 mg of THC per package under federal regulations, such that most edibles are sold in units of 2.0–2.5 mg of THC.<sup>44</sup> In contrast, edibles from the illicit market contain much higher labelled levels of THC—an average of almost 100 mg—but this labelling is often unreliable.<sup>45</sup> To our knowledge, only one other study has examined adverse events by product type and reported highly variable regional rates of adverse events from dried flower vs edibles based on clinical reports between 2016 and 2019.<sup>18</sup> Overall, there is a need for additional research on the extent to which different cannabis products are associated with both acute adverse events and longer-term health effects given the wide diversity of product types, including the increasing popularity of 'processed' cannabis extracts, such as edibles and high THC vaping products.<sup>40</sup>

The profile of adverse events from cannabis was generally consistent across sociodemographic groups, with the notable exception that younger consumers and males were more likely to seek medical help for an adverse event. This is consistent with the well-established finding that males report higher levels of cannabis consumption, while males and younger consumers are more likely to use higher THC solid extracts.<sup>40 46</sup> In regard to the frequency of cannabis use, monthly consumers were most likely to seek medical help, followed by daily/almost daily consumers and then weekly consumers. Compared with those who consume cannabis on a monthly basis, daily/weekly consumers have a greater opportunity to experience adverse events due to their frequency of use, however, they may also be more familiar with product types and consumption amounts. Less frequent consumers may have greater difficulty in dose estimations but may act more cautiously, and have fewer opportunities to experience adverse events. Finally, consistent differences were observed by ethnicity. Compared with consumers who

identified as white only, consumers who identified as black and several other minority groups were more likely to seek medical help and report experiencing cannabinoid hyperemesis syndrome, with similar patterns for seeking medical help at the ER. The higher risk of adverse events among racialised consumers is consistent with previous findings indicating higher rates of problematic cannabis use among non-white consumers, and warrants further attention given the legacy of the historical inequities in the criminalisation of cannabis use.<sup>47–49</sup> Future research should examine whether racial differences are associated with differences in consumption patterns, use of different product types or broader structural inequities that may enhance risk of adverse events.

### Limitations

The current study has several limitations common to population-based survey research. The study design is repeated cross-sectionally and cannot speak to individual-level changes over time. Respondents were recruited using non-probability-based sampling; therefore, the findings do not necessarily provide nationally representative estimates. However, the data were weighted by age group, sex, region, education (2018) and smoking status (in 2019–2021). Although there are no other probability-based samples with which to compare the current estimates of adverse events in Canada, the prevalence of cannabis use in the ICPS sample is moderately higher than Canada's national monitoring survey, although similar in regard to trends over time.<sup>35</sup> Among those who use cannabis, the profile of the ICPS sample is very similar to benchmark estimates for consumption amounts, frequency of use and the types of cannabis products used.<sup>35</sup> Additionally, self-reported survey data limits the ability to assess cases of cannabinoid hyperemesis syndrome, as respondents can misunderstand the severity of what the condition entails and incorrectly indicate having experienced it. Although the question on cannabinoid hyperemesis syndrome included the distinctive clinical indicator of the condition, 'repeated, severe vomiting from marijuana use', further validation on the prevalence of cannabinoid hyperemesis syndrome is necessary. Finally, the findings may have been influenced by social desirability bias and recall bias, which could result in the under-reporting of adverse events. Recall bias is likely to be greater for less distinctive events, including mild adverse events, than more serious adverse events. Despite these limitations, this population-based survey research can capture a wider scope of adverse events, as it includes a variety of settings. To date, virtually all published data on adverse events is from 'observational' healthcare administrative data. While these data provide reliable 'objective' data to examine trends over time, this type of data is known to underestimate adverse events.<sup>50</sup> Most studies examine data from a single healthcare setting (such as ERs), whereas people who consume cannabis may report adverse findings to a range of healthcare services outside of hospital settings, including poison centre calls, helplines and family physicians. Thus, any



one source is unlikely to capture the scope of adverse events. In addition, many individuals may not present to hospital or ERs for a variety of reasons, including a lack of access to healthcare services and concerns about anonymity. Under-reporting in healthcare settings may be greater for individuals from lower socioeconomic backgrounds, as well as those in jurisdictions where cannabis use remains 'illegal', which has the potential to bias comparisons between 'legal' and 'illegal' jurisdictions.

Although the overall sample size of the past 12-month consumers is a strength of the study, some of the subgroup analyses conducted only among those who sought medical help for adverse events had reduced statistical power, which limited the ability to detect changes over time. In addition, some questions were not asked in all survey years, including a lack of data from 2018 on cannabinoid hyperemesis syndrome, the use of non-ER health services, and the proportion of respondents who experience 'any' adverse event for which medical help was not sought (2018 and 2019). Changes prelegalisation and postlegalisation could not be assessed for these outcomes. Furthermore, two of the survey years, 2020 and 2021, occurred during the COVID-19 pandemic, which had an impact on cannabis use, as well as medical help-seeking for a wide range of other substances, as noted previously.<sup>39 51</sup> Longer-term surveillance over the postpandemic period is warranted to disentangle the effects of legalisation from pandemic effects. As cannabinoid hyperemesis syndrome develops from heavy, long-term cannabis use, longer-term surveillance is also warranted to assess for changes in its prevalence to evaluate any association with legalisation.<sup>4 5</sup> Finally, future studies should assess additional contextual information on adverse outcomes, including the prevalence of accidental injuries, as well as other substances that may have been used along with cannabis.

## CONCLUSIONS

Overall, a substantial proportion of consumers report experiencing adverse events from cannabis use. Although the vast majority of these events are likely to be non-life-threatening, transient effects due to overconsumption, they represent largely avoidable negative effects that place a burden on healthcare services. The widespread nature of the events also suggests a common problem of 'dosing', in which many consumers have a low understanding of the 'strength' of products in terms of THC levels and the corresponding amount of product to consume. The prevalence of adverse events among consumers has remained consistent from before to the first 3 years after non-medical cannabis legalisation in Canada. However, the overall number of adverse events may have increased in parallel to the increased prevalence of cannabis use and the types of medical help sought may have shifted. Finally, adverse events appear to be associated with a wide range of product types; however, there was a notable decrease in adverse events associated with edibles following legalisation, despite marked increases in cannabis edibles for the same period. The findings suggest that federal

product standards limiting the amount of THC in edibles may have reduced the likelihood of experiencing adverse events from edibles. Future studies should consider the risk of adverse events associated with specific product types, as well as racial/ethnic disparities in the experience of adverse events from cannabis use.

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**Ethics approval** The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#31330). See Technical Reports for additional methodological details ([www.cannabisproject.ca/methods](http://www.cannabisproject.ca/methods)). All participants gave informed consent before taking part. The data that support the findings of this study are available from the corresponding author, David Hammond, on reasonable request.

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**Supplemental Table S1. Adverse events experienced by people who consumed cannabis in the past 12-months, in 2020 and 2021**

	2020	2021
	n=4,993	n=5,727
Any adverse event*	29.2% (1,387)	29.9% (1,664)
Specific health effects		
Panic reactions	9.4% (468)	9.9% (567)
Feeling faint or dizzy or passing out	7.8% (389)	7.9% (451)
Nausea and/or vomiting	7.5% (374)	7.1% (406)
Depression	5.0% (247)	4.9% (281)
Dissociation/depersonalization	4.9% (243)	4.4% (254)
Lung or breathing problems	4.1% (203)	4.8% (276)
Heart or blood pressure problems	3.8% (191)	3.3% (190)
Hallucinations/psychosis	3.6% (178)	2.8% (159)
Flashbacks	2.0% (100)	2.6% (149)
Other	2.2% (111)	2.4% (136)
Serious adverse event**		
Any	5.9% (285)	6.5% (368)



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Persistent or significant disability or incapacity	2.8% (141)	3.1% (177)
Life-threatening reaction	2.3% (115)	2.6% (147)
In-patient hospitalization	1.7% (83)	2.5% (146)

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\* 48 excluded in 2020, and 64 excluded in 2021 due to 'refused'

\*\* 41 excluded in 2020, and 41 excluded in 2021 due to 'refused'

**Supplemental Table S2. Logistical regression model examining seeking medical help for adverse events from cannabis use in the past 12 months, among people who consumed cannabis in the past 12-months, 2018-2021\***

	% Sought help	Odds ratio	95% CI	P level
<b>Age</b>				
16-25	6.8%	5.53	3.6-8.47	.001
26-35	6.6%	4.78	3.20-7.14	.001
36-45	5.1%	4.06	2.64-7.14	.001
46-55	2.3%	1.99	1.24-3.18	.004
56-65	1.1%	Reference	Reference	Reference
<b>Sex at birth</b>				
Female	3.8%	Reference	Reference	Reference
Male	5.6%	1.31	1.08-1.59	.006
<b>Education level</b>				
Less than high school	4.4%	Reference	Reference	Reference
High school diploma or equivalent	4.6%	1.24	0.84-1.82	.282

Some college or technical vocation	4.0%	1.08	0.75-1.56	.689
Bachelor's degree or higher	6.5%	1.39	0.92-2.08	.116
Ethnicity				
Black only	18.2%	5.08	3.62-7.14	.001
East/South East Asian only	8.5%	2.17	1.47-3.22	.001
Indigenous only	4.7%	1.26	0.80-1.99	.321
Latino only	8.4%	2.26	1.21-4.19	.010
Middle Eastern only	10.7%	2.86	1.65-4.96	.001
South Asian only	15.6%	4.20	2.87-6.15	.001
Mixed/Other/Unstated	5.4%	1.45	1.02-2.07	.037
White only	3.3%	Reference	Reference	Reference
Income Adequacy				
Very difficult	5.7%	Reference	Reference	Reference
Difficult	3.8%	0.63	0.44-0.89	.009
Neither easy nor difficult	3.9%	0.57	0.40-0.79	.001
Easy	5.3%	0.77	0.54-1.09	.137
Very easy	7.7%	1.23	0.83-1.82	.308
Unstated	5.6%	0.74	0.38-1.46	.386



## Frequency of cannabis use

Past 12-month	2.9%	Reference	Reference	Reference
Monthly	7.2%	2.35	1.76-3.12	.001
Weekly	4.8%	1.58	1.14-2.18	.001
Daily/Almost daily	5.0%	1.94	1.46-2.59	.006

## Survey wave

Wave 1 - 2018	5.0%	Reference	Reference	Reference
Wave 2 - 2019	5.5%	0.99	0.70-1.40	.968
Wave 3 - 2020	4.2%	0.75	0.52-1.08	.124
Wave 4 - 2021	4.5%	0.76	0.54-1.08	.123

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\*Adjusted by cannabis use frequency, age, sex-at birth, education level, perceived income

adequacy, ethnicity, and survey wave

**Supplemental Table S3. Logistical regression model examining the lifetime experience of cannabinoid hyperemesis syndrome among people who consumed cannabis in the past 12-months, 2019-2021\***

	% Hyperemesis	Odds ratio	95% CI	P level
<b>Age</b>				
16-25	7.6%	1.12	0.89-1.41	.334
26-35	8.2%	1.15	0.95-1.38	.149
36-45	4.3%	0.81	0.68-0.96	.017
46-55	3.2%	0.98	0.83-1.16	.823
56-65	1.8%	Reference	Reference	Reference
<b>Sex at birth</b>				
Female	4.8%	Reference	Reference	Reference
Male	6.0%	0.99	0.86-1.14	.847
<b>Education level</b>				
Less than high school	6.1%	Reference	Reference	Reference
High school diploma or equivalent	5.0%	1.09	0.81-1.47	.571
Some college or technical vocation	4.5%	1.11	0.83-1.48	.474

Bachelor's degree or higher	7.1%	1.26	0.92-1.74	.158
Ethnicity				
Black only	18.4%	2.52	1.51-4.22	.001
East/South East Asian only	8.7%	1.22	0.81-1.83	.347
Indigenous only	7.2%	1.15	0.76-1.76	.513
Latino only	5.0%	0.71	0.37-1.37	.309
Middle Eastern only	10.9%	2.04	1.21-3.43	.008
South Asian only	16.6%	2.42	1.42-4.12	.001
Mixed/Other/Unstated	7.5%	0.98	0.70-1.38	.910
White only	3.8%	Reference	Reference	Reference
Income Adequacy				
Very difficult	7.6%	Reference	Reference	Reference
Difficult	5.2%	0.83	0.62-1.11	.212
Neither easy nor difficult	4.2%	0.67	0.50-0.89	.006
Easy	5.9%	0.85	0.62-1.16	.304
Very easy	7.6%	1.10	0.78-1.54	.593
Unstated	3.5%	0.11	0.07-0.17	.001
Frequency of cannabis use				
Past 12-month	4.3%	Reference	Reference	Reference



Monthly	6.6%	1.05	0.86-1.28	.657
Weekly	5.3%	1.09	0.91-1.32	.354
Daily/Almost daily	5.8%	0.92	0.76-1.10	.351
Survey wave				
Wave 2 - 2019	5.8%	Reference	Reference	Reference
Wave 3 - 2020	4.6%	0.79	0.66-0.94	.007
Wave 4 - 2021	5.8%	0.88	0.74-1.03	.116

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\*Adjusted by cannabis use frequency, age, sex-at birth, education level, perceived income adequacy, ethnicity, and survey wave

**Supplemental Table S4. Logistical regression model examining the use of the emergency department for seeking medical help, among people who consumed cannabis in the past 12-months that sought medical help for an adverse cannabis event in the past 12-months, 2018-2021\***

	% Used ED	Odds ratio	95% CI	P level
<b>Age</b>				
16-25	57.3%	1.23	0.53-2.86	.635
26-35	60.6%	1.19	0.52-2.76	.680
36-45	62.4%	1.97	0.82-4.74	.134
46-55	50.0%	0.96	0.35-2.63	.932
56-65	49.7%	Reference	Reference	Reference
<b>Sex at birth</b>				
Female	55.0%	Reference	Reference	Reference
Male	61.3%	1.09	0.72-1.66	.679
<b>Education level</b>				
Less than high school	55.0%	Reference	Reference	Reference
High school diploma or equivalent	56.1%	1.29	0.62-2.69	.494
Some college or technical vocation	55.2%	1.12	0.56-2.22	.753

Bachelor's degree or higher	67.2%	1.55	0.77-3.15	.221
Ethnicity				
Black only	79.0%	3.71	1.82-7.55	.001
East/South East Asian only	53.1%	0.93	0.43-2.01	.856
Indigenous only	61.1%	2.49	1.04-5.99	.042
Latino only	57.6%	1.43	0.46-4.45	.537
Middle Eastern only	65.0%	1.44	0.43-4.77	.551
South Asian only	69.3%	2.29	1.07-4.89	.033
Mixed/Other/Unstated	71.1%	2.64	1.27-5.50	.010
White only	51.2%	Reference	Reference	Reference
Income Adequacy				
Very difficult	51.5%	Reference	Reference	Reference
Difficult	52.9%	1.07	0.51-2.25	.867
Neither easy nor difficult	58.2%	1.26	0.62-2.58	.528
Easy	63.3%	1.41	0.67-2.99	.366
Very easy	69.3%	2.05	0.87-4.84	.102
Unstated	42.2%	0.43	0.11-1.68	.225
Frequency of cannabis use				

Past 12-month	51.1%	Reference	Reference	Reference
Monthly	68.0%	1.93	1.05-3.53	.011
Weekly	57.1%	1.17	0.60-2.26	.034
Daily/Almost daily	56.3%	1.16	0.67-2.00	.608
Survey wave				
Wave 1 - 2018	44.7%	Reference	Reference	Reference
Wave 2 - 2019	58.4%	1.95	0.97-3.91	.061
Wave 3 - 2020	59.6%	2.19	1.05-4.57	.038
Wave 4 - 2021	66.1%	2.70	1.36-5.37	.005

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\*Adjusted by cannabis use frequency, age, sex-at birth, education level, perceived income adequacy, ethnicity, and survey wave

**Supplemental Table S5. Chi square tests examining the frequency in which different forms of cannabis were used during people who consume cannabis' experiences of adverse events from cannabis use in the past 12-months by year, 2018-2021 (n=667)**

Form of Cannabis	2018	2019			2020			2021		
		Odds ratio	95%CI	P level	Odds ratio	95% CI	P level	Odds ratio	95% CI	P level
Dried herb	Ref	0.84	0.42-1.67	.621	0.88	0.42-1.83	.733	0.74	0.38-1.47	.393
Oil or liquid drops	Ref	0.82	0.40-1.69	.584	0.39	0.18-0.88	.023	0.79	0.39-1.63	.527
Oil or liquid capsules	NA	Ref	Ref	Ref	0.93	0.53-1.65	.810	0.94	0.59-1.52	.809
Oils or liquids for vaping	NA	Ref	Ref	Ref	0.77	0.37-1.60	.489	0.49	0.27-0.89	.020
Edibles/foods	Ref	0.10	0.04-0.28	.001	0.08	0.03-0.20	.001	0.06	0.02-0.18	.001
Hash or kief	Ref	0.37	0.14-1.01	.052	0.88	0.33-2.34	.802	0.48	0.19-1.20	.116
Concentrates	Ref	0.52	0.17-1.62	.259	0.62	0.19-2.01	.421	0.46	0.15-1.38	.166
Tinctures	Ref	0.57	0.12-2.77	.486	1.24	0.29-5.36	.776	0.67	0.16-2.82	.588
Drinks	Ref	1.74	0.56-5.37	.337	3.45	1.15-10.38	.028	2.11	0.75-5.89	.155



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Topical ointments	Ref	6.16	0.69-54.80	.103	4.95	0.54-45.40	.157	1.40	0.13-14.64	.778
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↑NA = Not Asked