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Research Paper

Changes in cannabis attitudes and perceptions in the five years following recreational legalization in Canada: Findings from an observational cohort study of community adults

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ABSTRACT

Background: Social acceptability and perceived risks/benefits are key attitudinal factors that influence substance use, and a major concern about cannabis legalization is an increase in more favourable attitudes ultimately leading to greater cannabis misuse. This study investigated perceptions of cannabis acceptability and risks/benefits over the 5 years following legalization in Canada, the first G7 nation to have legalized cannabis nationally, in a longitudinal observational cohort of community adults.

Methods: Participants (60 % female, median age = 29, 48% reporting cannabis use pre-legalization) were non-clinical adults from the general community who were assessed up to 11 times from September 2018 to October 2023 (mean waves = 9.9). Overall temporal attitudinal changes and whether changes were moderated by pre-legalization cannabis use status were examined.

Results: Significant increases over time were present for social acceptability of any recreational cannabis use (OR [95% CI]: 1.06 [1.05, 1.07]) and trying cannabis (1.02 [1.01, 1.03]), while acceptability of medical cannabis use decreased (0.95 [0.94, 0.96]). Meanwhile, regular cannabis use was perceived as riskier (0.97 [0.96, 0.98]) and addiction potential was perceived as greater (0.94 [0.93, 0.95]) over time. Perceived health-related benefits of cannabis were significantly less likely to be endorsed over time, while there were significant increases in perceived risks, including exacerbating stress, anxiety, and depression; exacerbating existing medical conditions; and disrupting sleep. Moderator analyses found participants not using cannabis pre-legalization showed significantly steeper increases towards greater social acceptability of occasional and regular use, and less steep increases in endorsement of cannabis-related risks.

Conclusions: Shifting social acceptability of cannabis post-legalization in Canada is paralleled by increases in perceived health-related risks and decreases in perceived benefits. Continued surveillance of attitudinal changes following legalization in Canada is warranted to inform the impacts in the largest national legal cannabis jurisdiction as well as other jurisdictions considering regulatory reform.

Introduction

Regulatory policies toward cannabis have changed dramatically over the last decade in North America. Arguably the largest change was Canadian legalization of non-medical (recreational) cannabis in 2018, the first G7 nation to do so. Given the dynamic policy landscape, understanding the consequences of legalization is of very high priority. Understanding how the public perceives risks, benefits, and social acceptability of substances is important, as these beliefs play a substantive role in subsequent population-level patterns of consumption. For example, as the health risks of tobacco were increasingly promoted to the public, the social acceptability and use of cigarettes substantially and steadily declined since the mid 20th century (Cloutier, Tremblay-Antoine, Dufresne, & Fréchet, 2022; Dai, Gakidou, & Lopez, 2022; Islami, Stoklosa, Drope, & Jemal, 2015). Thus, although lower risk perception and greater social acceptance may not necessarily be

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directly problematic, they are substantively related to behavioural changes in substance use (Cloutier et al., 2022; Florimbio et al., 2023; Grevenstein, Nagy, & Kroeninger-Jungaberle, 2015). Moreover, because attitudes and perceptions can potentially be more sensitive to shifts towards or away from normalization, they may forecast behavioural changes that take longer to become apparent due to environmental and contextual components of legalization (e.g., retail availability, evolving legal product market expansion). In other words, examining changes in attitudes following legalization is valuable to address impacts on the broader sociocultural 'climate' toward cannabis, which may in turn presage behavioural changes that take longer to manifest. Canadian cannabis legalization was relatively recent from a policy perspective, and while some literature has reported shifts in cannabis use frequency since legalization, most conclude that more data and time are needed to observe the impacts on behaviour (Doggett et al., 2025, 2023; Imtiaz et al., 2023; McDonald et al., 2024; Rubin-Kahana, Crépault, Matheson, & Le Foll, 2022).

Changes in attitudes are particularly relevant for the Canadian cannabis landscape post-legalization, as US research of cannabis-legal states (compared to non-legal states) has found that associations between lower-risk perceptions and greater cannabis use were strengthened after legalization (Mennis, McKeon, & Stahler, 2023). Although the US has tracked attitudes towards cannabis since the 1990s (Carliner, Brown, Sarvet, & Hasin, 2017), limited research has explored cannabis-related perceptions in the Canadian context. Evidence from the Canadian Cannabis Survey (CCS) (an annual repeat cross-sectional survey) suggests social acceptability of recreational cannabis use has increased, from 45% endorsing cannabis as socially acceptable in 2018 (just prior to legalization) to 51% in 2022 (Government of Canada, 2018, 2022). Interestingly, the CCS reports parallel increases in risk perceptions; 74% of participants perceived regular cannabis use as risky in 2022, which was a 2% increase from pre-legalization in 2018 (Government of Canada, 2018, 2022). Additional national data reports no changes in perceived approval of cannabis between 2018-2021, but increases in reported comfort of using cannabis openly (Winfield-Ward & Hammond, 2024). A key drawback of our current understanding of cannabis perceptions in Canada is the reliance on cross-sectional data, which is unable to capture within-individual attitude shifts across time. In this way, it is unclear if the shifts in cannabis perceptions observed in CCS or other cross-sectional data represent true changes over time, or whether the observed differences (or lack thereof) across time arise from the cohort effect of leveraging different samples. In order to address this limitation, longitudinal data which track attitude changes across time in the same cohort of individuals is needed.

To address this issue, the current study sought to leverage longitudinal data to investigate changes in public perceptions surrounding the social acceptability, safety, and risks and benefits of cannabis using a sample of Canadians who were monitored over the 5 years following legalization. Using data from a prospective cohort study that has tracked cannabis attitudes and perceptions approximately every 6 months since September 2018 (the month prior to legalization), this study addressed a number of gaps in the existing literature. Specifically, the first aim was to examine overall changes in perceptions and attitudes related to social acceptability, safety, and perceived risks and benefits of cannabis use during the first five years of legalization. Given that cannabis use is associated with substantial differences in cannabis attitudes (Turna, Balodis, Van Ameringen, Busse, & Mackillop, 2022; Winfield-Ward & Hammond, 2024), the second aim was to examine whether pre-legalization cannabis use status systematically affected attitudinal changes over time. Since alcohol is the most common substance used in Canada (Government of Canada, 2023), measures of alcohol acceptability and safety were also included to contextualize cannabis perceptions. Although cannabis use and other use-related variables are collected in this cohort, the focus of this study is exclusively on global attitudinal changes over time and those outcomes are reported independently (McDonald et al., 2024).

Methods

Design and Participants

This study leveraged data from a longitudinal cannabis legalization surveillance cohort study of community dwelling adults aged 18-65 living in Hamilton, Ontario or surrounding area who participated in an online REDCap (Harris et al., 2009) assessment every 6 months from September 2018 (T1), the month before legalization, to October 2023 (T11), the five-year anniversary of legalization. This was a prospective cohort study representing a purposive subsample of Canadians, and findings should be interpreted in the context that they may not be generalizable to all Canadians. Participants were originally recruited to the research registry via various forms of adverting (e.g., paper and online advertisements, email lists) for individuals with an interest in potentially participating in health-related research. Specifically, registry participants were eligible if they were: i) aged 18-65, ii) had 9th+ grade education (for literacy), iii) were willing to receive invitations to participate in future research studies, and iv) did not have any anticipated barriers that would prevent them from future studies (e.g., terminal illness). Enrollment in the registry consisted of a one-time in-person data collection session running from mid-September 2018 to mid-October 2018 (pre-legalization), and participants were subsequently invited to participate in the longitudinal cannabis legalization cohort, which involved subsequent data collection via periodic online REDCap assessments in April 2019, October 2019, April 2020, October 2020, April 2021, October 2021, April 2022, October 2022, April 2023, and October 2023. A total of 1502 individuals accepted the invitation and provided informed consent. Participants received an online gift card ($40 CAD) upon completion of each wave, and throughout the study were occasionally (4 times throughout the study) entered into raffle draws for a technology device (valued up to $1500 CAD). In each study wave, participant surveys were assessed using 5 quality control items intended to gauge survey effort and attention (e.g., "In response to this question, please choose the option, 'Nearly every day'"). Participant observations were considered invalid if they did not pass at least 3 of 5 five quality control measures. All procedures were approved by the Hamilton Integrated Research Ethics Board (Project #4699).

All measures used in the present study were collected at all 11 time points among all participants, with the average participant participating in 9.9 (SD = 2.3) of 11 waves (mean retention across waves = 89.7%); missing data handling is described in the Statistical Analyses section. A total of 1479 (98.5%) people passed quality control (QC) measures at baseline, and mean QC across all waves was 99.4%. At baseline, the sample had a greater number of females (59.8%, n=884) compared to males (40.2%, n=595). The majority of the sample was White/European Ancestry (79.2%, n=1172) and reported income of $60 000 CAD or more per year (57.7%, n= 854). Approximately half of the sample reported no cannabis use at baseline (52.1%, n= 770), while 21.9% (n=324) used monthly or less, 6.8% (n=101) used 2-4 times per month, 8.0% (n=118) used 2-3 times per week, and 11.2% (n=166) used 4 or more times per week. A COSORT diagram and fulsome baseline characteristics are provided in Supplemental Materials. The demographic makeup of this sample is comparable to national estimates, although income and education are higher in the present sample; a more detailed contrast of this sample with provincial and national estimates is available elsewhere (Levitt et al., 2022).

Measures

Acceptability

Individuals were asked about the social acceptability of three substance use behaviours (cannabis for medical purposes, cannabis for non-medical purposes, alcohol) based on a 5-point Likert scale (completely unacceptable, somewhat unacceptable, no opinion, somewhat acceptable, completely acceptable) through questions adapted from the

Canadian Cannabis Survey (Health Canada, 2023): "How socially acceptable do you think it is for a person to use the following substances regularly?" One additional behaviour (trying cannabis once or twice) was adapted from the National Survey on Drug Use and Health and used a slightly different 5-point Likert scale ranging from strongly disapprove to strongly approve through the question "How do you feel about adults trying cannabis once or twice for non-medical/recreational purposes?" (Salas-Wright, Hai, Oh, Alsolami, & Vaughn, 2021).

Safety

Risk of consuming cannabis occasionally was assessed by adapting a measure from the National Survey on Drug Use and Health (Lipari & Jean-Francois, 2014) "How much do people risk harming themselves physically and in other ways when they use cannabis once or twice a week?" (no risk, slight risk, moderate risk, great risk). Participants were also asked about how they perceived the safety of several facets of cannabis using questions from a national survey of US adults (Keyhani et al., 2018). Addictiveness of cannabis was assessed by asking participants "How addictive is marijuana?" with three response levels (not at all, somewhat, very). Perceptions of safety for pregnant women was assessed by asking "How safe is marijuana use for pregnant women?" (completely unsafe, somewhat unsafe, somewhat safe, completely safe). Two of the safety measures contrast cannabis with alcohol use: "How does driving under the influence of marijuana compare with driving under the influence of alcohol?" and "How does smoking 1 marijuana joint per day compare with drinking 1 glass of wine per day?" where the response options were: much less safe, somewhat less safe, equally safe, somewhat safer, much safer. Notably, some safety measures use the term "marijuana" rather than cannabis to reflect the terminology of the original scale, however participants are made aware at the outset of the survey that although questions may use differing phrasing, cannabis and marijuana should be considered equivalent terms.

Risks and Benefits

Individuals were asked about numerous perceived risks and benefits of cannabis use using two select-all-that-apply questions from a national survey of US adults (Keyhani et al., 2018). Benefits of cannabis use that participants could endorse included pain management; treatment of disease (such as epilepsy or multiple sclerosis); relief from stress, anxiety, or depression; improved appetite; improved sleep; help decreasing of stopping other medicines; improved creativity; improved focus or concentration; and increased energy. Risks of cannabis use that participants could endorse included legal problems; addiction to cannabis; impaired memory; increased use of other drugs; personal or relationship problems; decrease in intelligence; decrease in energy; new or worsening health problems; increase in stress, anxiety or depression; and disrupted sleep.

Statistical Analyses

Generalized linear mixed models (GLMMs) were used to examine how perceptions across the social acceptability, safety, and risks and benefits domain shifted over time. Participant random effects were included in all models to capture non-independence of within-person observations over time. Social acceptability and safety outcomes were modelled as ordinal through cumulative link mixed models, such that an increase in the outcome reflected a more positive (or in the case of safety measures, safer) perception. As such, the reference category for all ordinal models was the lowest perception of acceptability (completely unacceptable/strongly disapprove) or the lowest perception of safety (i.e., great risk, very addictive, or completely unsafe). In this way, model effects can be interpreted such that a one unit increase in time (i.e., every 6 months) is associated on average with X increased (or decreased) likelihood of a more acceptable, or safer perception. In other words, a significant OR >1 indicates that on average perceptions improved over time (i.e., more acceptable, safer), whereas a significant OR<1 indicates that on average, perceptions worsened over time (i.e., less acceptable, less safe). Endorsement of risks and benefits were modelled as binary (endorsed, not endorsed). In order to address missing data due to attrition or intermittent unit non-response over the 11 waves of data collection (28% of participants missing some data), outcomes were modelled using a joint analysis and Bayesian imputation framework through the R package JointAI (Erler, 2023; Erler, Rizopoulos, & Lesaffre, 2021) alongside the use of the ordinal package (Christensen, 2023), which implements the cumulative link function. Convergence and precision of posterior estimates were evaluated using Gelman-Rubin criterion and Monte Carlo error, aligning with existing recommendations (Erler et al., 2021).

Given the challenges in interpreting main effects alongside interaction effects, aims 1 and 2 of this study were modelled separately. Overall changes over time are modelled for each outcome in effect of time models, controlling for age, sex (female, male), ethnicity (historically marginalized groups [includes Black, East Asian, South Asian, Southeast Asian, Middle Eastern, First Nations/Inuit/Metis, Pacific Islander, Latinx/Hispanic, Other, or more than one of the listed population groups], White/European Ancestry), and annual income (<60k, 60k+), and pre-legalization cannabis use (none vs. some). Since time was the main parameter of interest, it was treated as continuous in all models to allow for the direct practical interpretation of the average effect. To assess for moderating effects, separate time*cannabis use models examine interaction effects between time and pre-legalization cannabis use. If a significant interaction term was found, interaction plots were created to aid in comprehension and are available in supplemental materials. The Bayesian imputation framework did not allow for extraction of estimated marginal means, so these plots are based on non-imputed models. Despite this limitation, the joint Bayesian approach was preferred over complete case analysis to manage any attrition bias, and was preferred over traditional multiple imputation by chained equations because it is less prone to model misspecification (Erler et al., 2016, 2021). Notably, interaction plots are only shown for illustrative purposes, and for all plotted interactions, the significance and direction of association were the same and effect sizes were comparable between imputed and non-imputed models. To reduce type 1 error rate, we used the more conservative $p<0.005$ threshold for interpreting significance throughout (Benjamin et al., 2018). This study and reporting of findings adhere to STROBE reporting guidelines (von Elm et al., 2008).

Results

Table 1 present the results of generalized linear mixed models. Social acceptability and safety models are organized such that a significant odds ratio (OR) above 1 represents a shift towards more positive views (i.e., greater social acceptability, safer), while an OR less than 1 represents more negative views (i.e., less social acceptability, less safe, less support for legalization). Similarly, binary risk and benefit models represent likelihood of endorsing that risk, or benefit, over time. As time was treated as continuous, effect sizes of time can be interpreted directly as a unit of 6 months (the time between data collections). For example, recreational cannabis use (OR [95% CI]: 1.06 [1.05, 1.07]) was 6% more likely to be perceived as more socially acceptable for every 6 months that passed in this study. Effects can also be interpreted additively for all waves, e.g., compared to baseline in 2018, there was 60% greater likelihood that recreational cannabis use was perceived as more acceptable by October 2023. Interpretation of interaction effects is more complex than single terms, so plots of marginal effects for significant interactions are given in Supplemental Materials to aid in comprehension.

Social Acceptability

Fig. 1 demonstrates how acceptability ratings of cannabis use (recreational, medical, and trying once or twice) changed over time, including contrast to alcohol use. Descriptively, the prevalence of

Table 1
Results of GLMMs examining measures related to social acceptability, safety, and risks and benefits of cannabis use (T1-T11).

	Effect of Time Models[1]:				Time*Cannabis Use Models[1,2]	
	OR (95% CI)	p-value	Odds interpretation (every 6 months)[3]	Odds interpretation (all waves) [3]	OR (95% CI)	p-value
Social Acceptability[2]						
Regular Cannabis (Recreational) Use	1.06 (1.05, 1.07)*	<0.001	+ 6%	+ 60%	0.94 (0.92, 0.96)*	<0.001
Trying Cannabis Once/Twice	1.02 (1.01, 1.03)*	0.001	+ 2%	+ 20%	0.89 (0.87, 0.92)*	<0.001
Regular Cannabis (Medical) Use	0.95 (0.94, 0.96)*	<0.001	- 5%	- 50%	0.95 (0.92, 0.97)*	<0.001
Regular Alcohol Use	0.97 (0.96, 0.98)*	<0.001	- 3%	- 30%	0.99 (0.97, 1.02)	0.6079
Safety[2,4]						
Risk of Regular Cannabis Once/Twice per Week	0.97 (0.96, 0.98)*	<0.001	- 3%	- 30%	0.89 (0.87, 0.91)*	<0.001
Addictiveness of Cannabis	0.94 (0.93, 0.95)*	<0.001	- 4%	- 40%	0.91 (0.88, 0.93)*	<0.001
Safety During Pregnancy	1.02 (1, 1.03)	0.0156	-	-	0.97 (0.94, 1)	0.054
Safety Compared to Alcohol Consumption	1.06 (1.05, 1.07)*	<0.001	+ 6%	+ 60%	0.95 (0.93, 0.97)*	<0.001
Driving Impairment Compared to Alcohol	0.98 (0.97, 0.99)*	<0.001	- 2%	- 20%	0.94 (0.92, 0.96)*	<0.001
Perceived Benefits[2]						
Pain Management	0.94 (0.92, 0.97)*	<0.001	- 6%	- 60%	1.03 (0.98, 1.09)	0.2252
Treatment of Disease	0.98 (0.96, 0.99)*	0.0027	- 2%	- 20%	0.98 (0.95, 1.02)	0.3143
Relief from Stress, Anxiety or Depression	0.94 (0.92, 0.95)*	<0.001	- 6%	- 60%	0.97 (0.94, 1.01)	0.1269
Improved Appetite	1.03 (1.01, 1.05)*	0.0012	+ 3%	+ 30%	0.99 (0.96,1.03)	0.6345
Improved Sleep	0.98 (0.97, 1)	0.0454	-	-	0.91 (0.88, 0.94)*	<0.001
Helps Decrease or Stop other Medications	0.97 (0.96, 0.99)*	<0.001	- 3%	- 30%	1.01 (0.98, 1.04)	0.5277
Improved Creativity	1.02 (1, 1.03)	0.0487	-	-	0.94 (0.91, 0.97)*	<0.001
Improved Focus or Concentration	1.03 (1.01, 1.05)*	0.0045	+ 3%	+ 30%	0.95 (0.92, 0.99)	0.0141
Increased Energy	1.03 (1.01, 1.05)	0.0159	-	-	0.96 (0.92, 1)	0.0401
Perceived Risks[2]						
Legal Problems	0.91 (0.9, 0.93)*	<0.001	- 9%	- 90%	0.94 (0.92, 0.97)*	<0.001
Addiction	1.06 (1.04, 1.07)*	<0.001	+ 6%	+ 60%	1.11 (1.07, 1.14)*	<0.001
Impaired Memory	1 (0.98, 1.01)	0.9626	-	-	1.01 (0.98, 1.04)	0.4578
Increased use of Other Drugs	1.02 (1, 1.03)	0.0338	-	-	1.07 (1.04, 1.1)*	<0.001
Personal or Relationship Problems	1 (0.99, 1.01)	0.9025	-	-	1.04 (1.01, 1.07)*	0.0038
Decrease in Intelligence	0.99 (0.98, 1.01)	0.3667	-	-	1.04 (1, 1.07)	0.0258
Decrease in Energy	0.98 (0.97, 1)	0.0163	-	-	1.02 (0.99, 1.04)	0.2569
New or Worsening Health Problems	1.04 (1.03, 1.06)*	<0.001	+ 4%	+ 40%	1.07 (1.04, 1.11)*	<0.001
Increase in Stress, Anxiety, or Depression	1.05 (1.03, 1.06)*	<0.001	+ 5%	+ 50%	1.06 (1.02, 1.09)*	<0.001
Disrupted Sleep	1.06 (1.04, 1.07)*	<0.001	+ 6%	+ 60%	1.07 (1.04, 1.11)*	<0.001

[1] All models controlled for age, sex, ethnicity, income, and baseline cannabis use. Interaction models also include required standalone time and cannabis use variables.

[2] Models with significant interaction effects are presented graphically in Figs. 1-3

[3] It is important to interpret regression effects appropriately; these columns represent % change in likelihood rather than descriptive changes in prevalence. For example, recreational cannabis use was 6% more likely to be perceived as more socially acceptable for every 6 months that passed in this study, or in total across all waves (2018-23) it was 60% more likely that recreational cannabis use was perceived as more acceptable at the 5-year mark.

[4] While all safety models were ordinal, not all outcomes contained the same number of scale items. Effect sizes between different models should not be directly compared.

* Significant at $p<0.005$

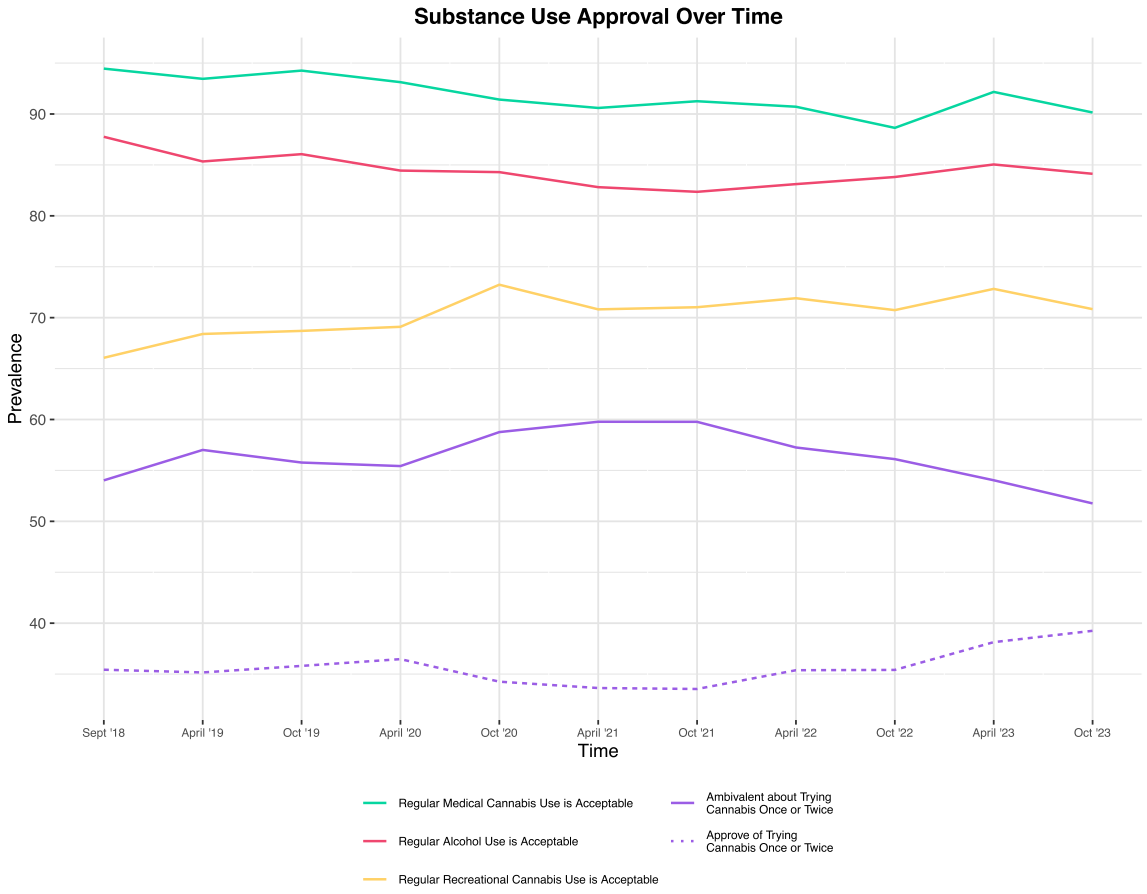

Fig. 1. Social Acceptability of Substance Use Behaviours
Descriptive changes in social acceptability over time. Colours differentiate measures while line style differentiates levels within the same measure, where relevant. A mean comparison of each social desirability item visualized on their original scale is also available in Supplemental Materials.

perceiving recreational cannabis use as acceptable (compared to unacceptable or no opinion) increased from 66.1% (T1) to 70.8% (T11) while acceptance of medical use decline from 94.5% (T1) to 90.1% (T11). Effect of time models support this, indicating that on average, the likelihood of social acceptability of recreational cannabis use and trying cannabis once or twice both significantly increased over time, while the likelihood of acceptability decreased for medical cannabis use and regular alcohol use.

Safety

Fig. 2 demonstrates how different safety facets of cannabis changed descriptively over time; attitudes shifted towards cannabis and alcohol being equally impairing for driving, and away from ratings that cannabis impairment was safer. Evaluations that cannabis carries no risk or that cannabis is not addictive steadily declined, with 24.8% and 24.7% prevalence respectively in 2018 declining to 14.2% and 15.6% by October 2023. Effect of time models were consistent with descriptive trends and change in likelihood were significant for most safety measures; regularly consuming cannabis once or twice a week was perceived as riskier over time, and perceptions of addictiveness increased. Additionally, perceptions of the safety of cannabis contrasted with alcohol use increased in likelihood over time, while the safety of driving impairment compared to alcohol impairment decreased. Although these two alcohol contrasts had opposite direction of effects, based on where risk perceptions began, both associations represent trends towards greater likelihood of rating cannabis and alcohol risks as equal. There were no significant changes in the likelihood of rating of the safety of cannabis for pregnant women as more or less safe over time.

Significant interactions were present for perceived risk of regular cannabis use; addictiveness of cannabis; safety compared to alcohol consumption; and impairment compared alcohol impairment. Overall, the interactions generally reflected steeper increases towards perceiving cannabis as safer among those who did not use cannabis pre-legalization. Illustrative plots of these interactions are available in Supplemental Figure 4.

Risks and Benefits

Fig. 3 presents the descriptive trends of risk and benefit endorsement over time for the measures that changed significantly in the effect of time models. Models indicated that participants were significantly less likely to endorse several benefits of cannabis use, including pain management; relief from stress anxiety, or depression; and help with decreasing or stopping other medications, over time. Meanwhile, the likelihood of endorsing improved appetite and improving concentration increased over time. Significant interactions with pre-legalization cannabis use were present for endorsement of improved sleep and creativity.

Significant increases were present for risk of addiction; new or worsening health problems; increase in stress, anxiety, or depression; and disrupted sleep increased over time. As expected, the likelihood of endorsing legal problems as a risk significantly decreased over time. Pre-legalization cannabis use moderated the likelihood of endorsing several risks including addiction; increased use of other drugs; personal or relationship problems; new or worsening health problems; increased

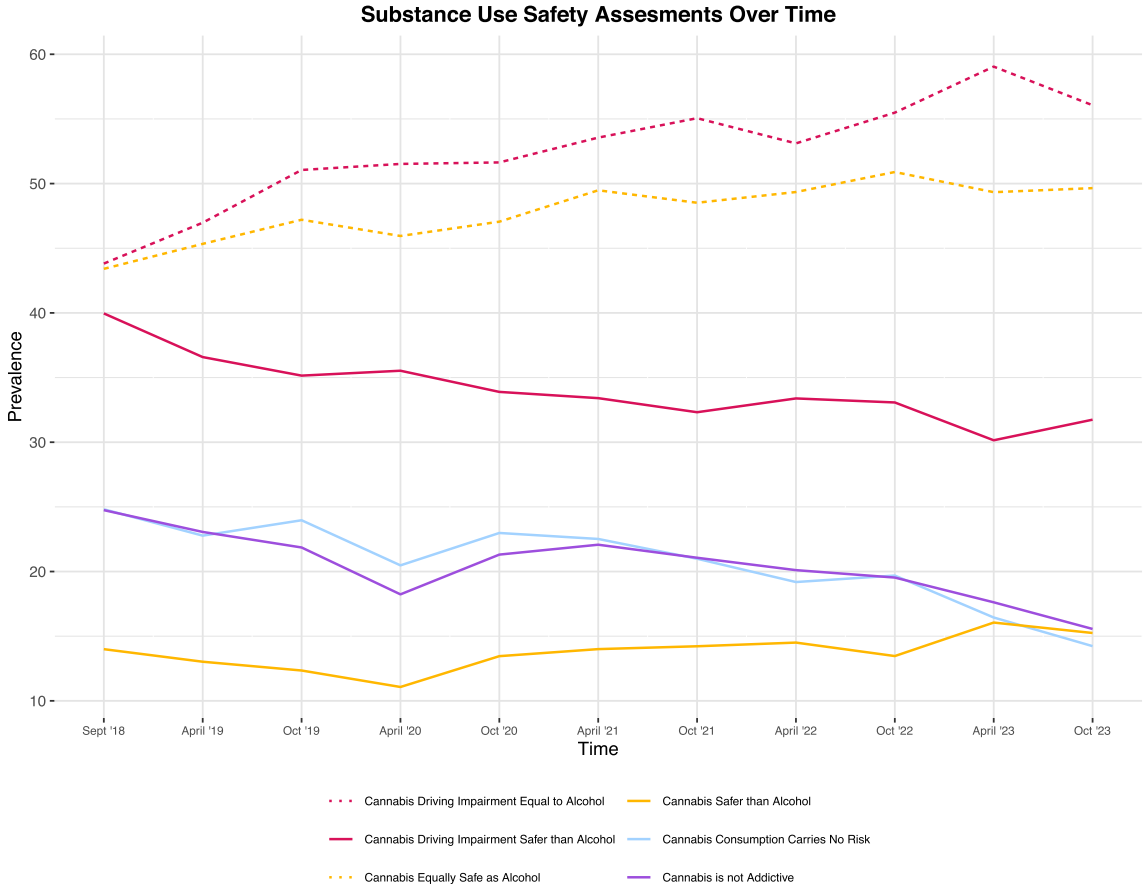

Fig. 2. Perceived Safety of Cannabis Use Behaviours
Descriptive changes in perceived safety over time. Colours differentiate measures while line style differentiates levels within the same measure, where relevant. Only measures which changed significantly over time are shown.

stress, anxiety or depression; and disrupted sleep, such that those who used cannabis pre-legalization were more likely to endorse these risks over time. Pre-legalization use also moderated the likelihood of endorsement of legal problems as a risk; declines in endorsements were steeper for those who used cannabis pre-legalization. Illustrative plots of these interactions are available in Supplemental Figure 5.

Discussion

To our knowledge, this was the first study to evaluate how cannabis attitudes and perceptions have shifted in Canada since recreational legalization using a within-subjects longitudinal design. Findings demonstrated an overall increase in social acceptability of cannabis use, with the exception of medical cannabis use where acceptability declined. Measures related to cannabis safety, risks, and benefits appeared to shift towards more cautious perceptions and greater uncertainty surrounding the health benefits of cannabis. These findings appear largely positive from a public health perspective, as increases in acceptability were not at the expense of diminishing safety perceptions but instead were paralleled by more cautious consideration of safety and more thorough evaluation of risks. These gradual shifts may forecast changes that will continue in the post-legalization climate, but further monitoring and examination in other prospective samples is needed.

Changes in Social Acceptability of Cannabis

Longitudinal models demonstrated that acceptability of regular recreational cannabis use and trying cannabis once or twice grew over time. This is consistent with the Canadian Cannabis Survey's repeat-cross-sectional trends, which report that acceptability of cannabis use has been increasing since 2018 (Government of Canada, 2024). Increasing acceptability of recreational use is consistent with what may have been expected in a post-legalization climate, based on US tracking of cannabis attitudes (Carliner et al., 2017; Miech et al., 2015). However, somewhat unexpectedly, this study found a significant decline in medical cannabis use acceptability over time, albeit modestly as the majority of opinions tended to shift from "completely" to "somewhat" acceptable. These modest declines may arise from individuals questioning the purely medical use of cannabis, given that post-legalization, the majority of those who use for medical purposes also report recreational use (Turna et al., 2020). Participants may also be reacting to increasing calls to question the evidence for cannabis as a treatment for anxiety and depression (Black et al., 2019; Mammen et al., 2018; Tibbo et al., 2020; Van Ameringen, Zhang, Patterson, & Turna, 2020). This latter hypothesis aligns with how perceived risks and benefits shifted in this study by October 2023, people were significantly less likely to endorse relief from stress, anxiety or depression as a benefit over time, and were significantly more likely to endorse increased stress, anxiety, and depression as a cannabis-related risk.

When social acceptability trends over time were disentangled by cannabis use status, patterns demonstrated that those not using cannabis pre-legalization showed steeper increases towards acceptance. Similar patterns were also observed for safety of consuming cannabis once or twice a week as well as safety of cannabis use compared to alcohol. In other words, those not using cannabis pre-legalization tended to shift their opinions to being more favourable towards cannabis (more

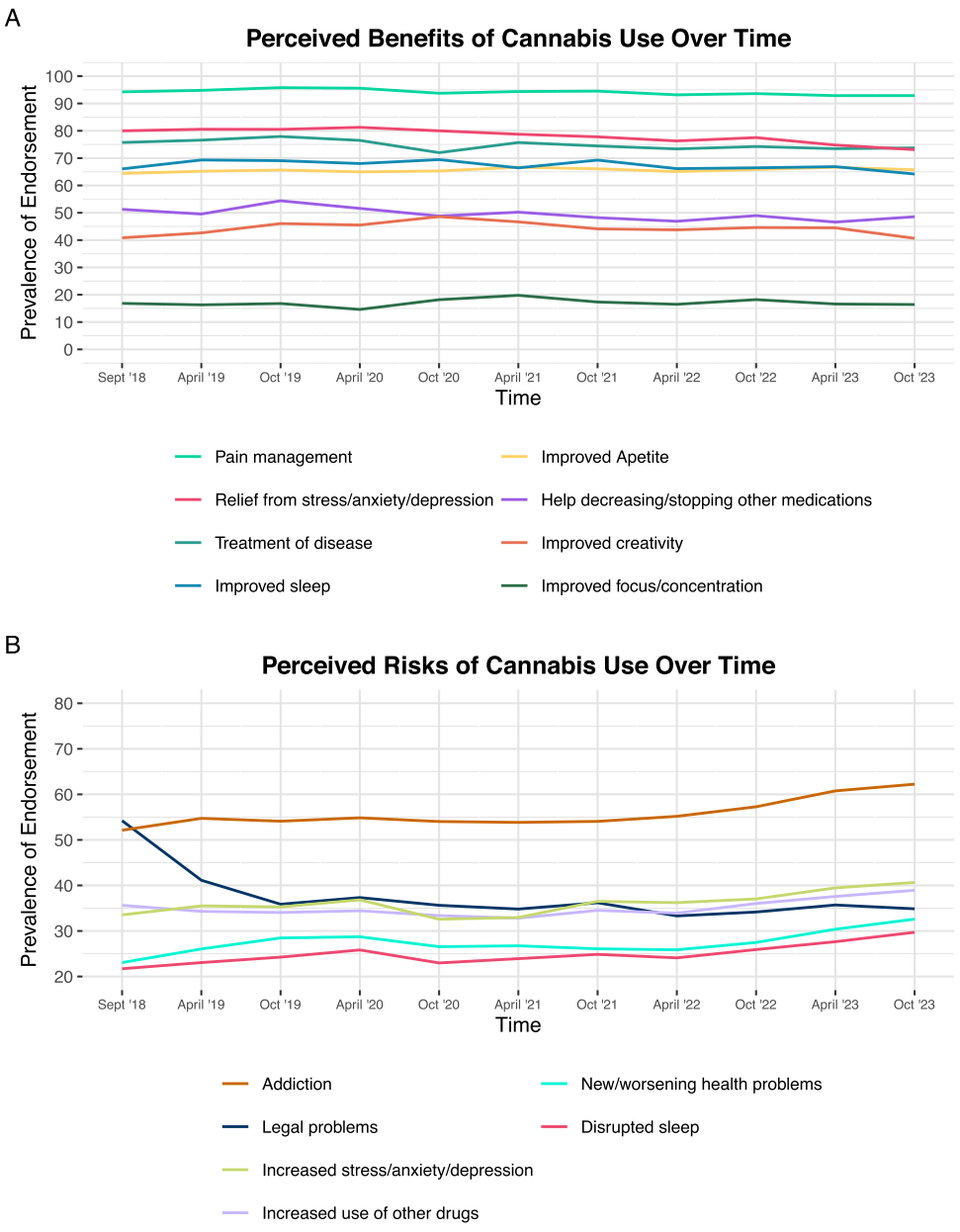

Fig. 3. Perceived Risks and Benefits of Cannabis Use
Descriptive changes in endorsed benefits and risks of cannabis over time. Only measures which changed significantly over time are shown.

acceptable, safer), at a greater rate than those who were using cannabis pre-legalization. While this may seem unexpected, those using cannabis pre-legalization tended to already have positive opinions, whereas those who were not tended to have less extreme opinions, and thus had more space to shift their views over time. Overall, these patterns indicate that increasing normalization of cannabis in this sample of Canadians was most pronounced among those who were not already engaged in cannabis use prior to legalization.

Changes in Safety, Risk, and Benefit Perceptions

In contrast to the findings of increased social acceptability, individuals generally had declining safety perceptions related to cannabis; they reported riskier perceptions of regular cannabis consumption, as well as perceived cannabis as more addictive, over time. Moreover, nearly half of the potential benefits examined showed decreased likelihood of endorsement over time, and four of the ten risks showed increased likelihood of endorsement, in contrast to only one that decreased (legal problems). Changes over time in risk and benefit endorsement reflect less confidence in health-related benefits of cannabis use (pain management; treatment of disease; relief from stress, anxiety or depression; help decreasing or stopping other medications), and instead greater concern towards health-related risks (addiction; new or worsening health problems; increased stress, anxiety, or depression; disrupted sleep). Interestingly, those who used cannabis pre-legalization were more likely to endorse several risks (addiction, new/worsening health problems, disrupted sleep, increased stress/anxiety/depression) over time compared to those not using cannabis pre-legalization. These steeper increases could be due to a number of reasons, but one plausible mechanism is that individuals who personally experienced cannabis-related problems may be more likely to report certain risks over time.

The changes observed in this study demonstrate increased skepticism of the benefits of cannabis and a more cautious evaluation of the risks since legalization; this provides valuable context that aforementioned

findings surrounding increased social acceptability are not a result of more relaxed views surrounding cannabis safety. This increased evaluation of risks over time is consistent with cross-sectional findings from the CCS (Government of Canada, 2024) but is in contrast to steady declines in risk evaluation of cannabis observed in the US (Carliner et al., 2017; Mennis et al., 2023). The heightened caution surrounding cannabis in Canada in this sample since legalization may signal some success of the strict federal regulations on cannabis-related advertising and promotion, which outline that almost all forms of cannabis promotion or advertising is prohibited, including specific prohibition on making health-related claims of cannabis (Government of Canada, 2025). Interestingly, and counterintuitive to the patterns of increasing risk evaluation, is that the CCS has also reported that rates of seeing cannabis-related public health messaging have drastically decreased from 76% in 2018 to 50% in 2023 (Government of Canada, 2024). It is possible that other sources of information (e.g., news, social media) are influencing risk evaluations, however given the context that this is a longitudinal sample, some increases in risk evaluation may be related less to external factors and instead be confounded by an increase in caution with age.

Contrasting Cannabis with Alcohol

In addition to examining social acceptability and safety of cannabis, we also examined counterfactual alcohol-related measures; this was to contextualize how perceptions of cannabis may be shifting towards or away from alcohol, which is the most commonly used substance in Canada (Canadian Centre on Substance Use and Addiction, 2019). Opposite to cannabis acceptability, longitudinal models demonstrated that acceptability of regular alcohol use declined. Although overall acceptability of alcohol remains greater, these results imply that these substances may be trending towards equal long term. Measures which contrasted facets of safety between cannabis and alcohol showed similar trends; safety perception of cannabis consumption compared to alcohol increased over time, shifting mostly from ratings of "somewhat less safe" towards equal. Perceptions of driving impairment from cannabis similarly shifted, being more likely to be rated as equal to alcohol impairment over time.

Strengths and Limitations

To our knowledge this is the first study to examine longitudinal changes in cannabis attitudes in Canada since the federal legalization of cannabis. The longitudinal nature of these data allowed for the examination of between-person trends while adjusting for within-person trends, which can speak more strongly to how opinions shift over time compared to repeat-cross-sectional data. This study also leveraged a joint imputation and analysis approach to handle missing data across time, limiting potential bias that may arise due to attrition, which is particularly important in substance use research (McPherson, Barbosa-Leiker, Burns, Howell, & Roll, 2012). Nonetheless, findings should be interpreted in the context of this study's limitations. First, this cohort comprises individuals originally recruited from a research registry in a single city and thus may not be representative of the overall Canadian population. Although comparisons to national and provincial population demographics suggest high similarity (Levitt et al., 2022), caution should be exercised in terms of generalizability. Additionally, although the longitudinal nature of these data are a strength in that they capture within-person changes, a limitation of using prospective cohort study data in this context is that participant opinions may naturally evolve as they age, and these changes cannot be fully disentangled from external environmental or policy factors of interest (e.g., legalization). Next, although the cohort included a large age range, adolescents, who represent an important cohort in substance use research, were not included. These data also contain only one pre-legalization time point, and as such we were not able to examine whether the shifts in perceptions may have been impacted by the passing of the Cannabis Act Bill C-45 which occurred in June 2018. Lastly, these data also include the COVID-19 pandemic period; research has reported shifts in cannabis use during this time (particularly during strict public health measures such as lockdowns) (Mehra et al., 2023) and it is feasible that COVID impacts may have also extended to attitudes and opinions of cannabis.

Conclusions

In this longitudinal cohort of community adults, numerous perceptions of cannabis in Canada significantly shifted since legalization, including increases in the social acceptability of recreational cannabis use and decreases in acceptability of medicinal use. Meanwhile, safety and risks perceptions reflected increased caution as well as increased skepticism surrounding the benefits of cannabis. Taken together, findings suggest increased normalization of cannabis use over the five years following Canadian recreational legalization in this sample, but not at the expense of compromising perceptions towards cannabis safety.

CRediT authorship contribution statement

Amanda Doggett: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Kyla L. Belisario:** Writing – review & editing, Validation, Methodology, Data curation, Conceptualization. **André J. McDonald:** Writing – review & editing, Validation, Methodology, Conceptualization. **Jane De Jesus:** Writing – review & editing, Resources, Project administration, Investigation. **Emily Vandehei:** Writing – review & editing, Project administration, Investigation. **Jessica Gillard:** Writing – review & editing, Project administration, Investigation. **Laura Lee:** Writing – review & editing, Project administration, Investigation. **James MacKillop:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

JM is a principal in Beam Diagnostics, Inc. and has consulted to Clairvoyant Therapeutics, Inc. All other authors report no conflicts of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2025.104782.

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