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Original quantitative research

Adherence to Lower-Risk Cannabis Use Guidelines among Canadian college students: a regression analysis

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Abstract

Introduction: The objective of this study is to evaluate adherence to seven Canadian Lower-Risk Cannabis Use Guideline (LRCUG) recommendations among Canadian university students and identify subgroups of high-risk users.

Methods: We analyzed survey data collected across four Canadian universities under the World Mental Health-International College Student (WMH-ICS) initiative. Seven of the ten 2017 LRCUG recommendations were evaluated. Zero-inflated Poisson models were employed to examine the sociodemographic correlates of (1) any lifetime cannabis use; and (2) the number of unmet LRCUG recommendations, conditional on lifetime use. Additionally, multivariable binary logistic regression models examined the sociodemographic correlates of adherence to individual recommendations.

Results: Among the 27 236 respondents, the prevalence of lifetime cannabis use was 33.8%. Of the seven recommendations evaluated, "choosing lower-strength cannabis products" had the lowest adherence rate (29.0%), followed by "not smoking cannabis" (36.7%). "Not using synthetic cannabis" had the highest adherence rate (96.1%), followed by "delaying cannabis use until age 16" (91.2%). Men, non-heterosexual students, students living in shared housing, and domestic students were more likely to use cannabis and, among users, reported risky use. While White students were more likely to use cannabis, among users, many non-White student groups reported riskier use.

Conclusion: Although most students did not use cannabis and many of the LRCUG recommendations had high rates of adherence, there were low rates of choosing lower-strength cannabis products and avoiding smoking cannabis among users. Study findings highlight specific recommendations and subpopulations to inform tailoring of future interventions targeting university students.

Keywords: *cannabis, substance-related disorders, students, adolescents*

Highlights

- One third of Canadian university students surveyed reported using cannabis in their lifetime.
- Optimistically, 91.2% of users reported delaying cannabis use until age 16 and 96.1% of users reported avoiding synthetic cannabis.
- Among users, the most commonly reported risky cannabis use behaviours were not choosing lower-strength cannabis products (71.0%) and smoking cannabis (63.3%).
- Riskier cannabis use was more common among men, non-heterosexual students, students living in shared housing, and domestic students.
- Further efforts are needed to promote literacy about lower-risk cannabis use among university students and increase the availability of lower-potency cannabis products. The adoption of a THC standard unit on labels should also be considered.

Introduction

Despite decades of prohibition and criminal sanctions, Canada has among the highest rates of cannabis use in the world, with a lifetime prevalence of nearly 50% among Canadian adults.[1-3] In 2018, the Canadian Government passed the *Cannabis Act* to legalize recreational (i.e. non-medical) cannabis use for adults (aged 18 years or older) with a goal of providing a quality-controlled supply of cannabis products, minimizing illicit cannabis-related activities, and reducing burden on the criminal justice system.[4] According to the Canadian Substance Use Survey, 12-month cannabis use increased from 22% in 2018 (prelegalization) to 27% in 2022 (post-legalization).[5]

While recreational cannabis use is both legal and relatively common in Canada, the substance is associated with many adverse health outcomes such as respiratory and cardiovascular disorders, cognitive impairment, addiction, psychosis and schizophrenia.[6-10] Further, the THC in cannabis can interfere with brain development, particularly within the frontal cortex. Given the human brain continues developing into the early 20s, adolescents

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and young adults may be particularly vulnerable to the adverse effects of cannabis use.[11,12] Of note, a recent Ontario-based cohort study identified a 60% increase in psychosis incidence among people aged 14 to 20 between 1997 and 2023, aligning with increased rates of cannabis and other substance use.[13]

Many of these associations require further research, but the literature to date suggests that these adverse outcomes are typically concentrated among a small group of high-risk consumers, and can be substantially mitigated by informed behavioural choices.[14] This knowledge led to the development of the Canadian Lower-Risk Cannabis Use Guidelines (LRCUG), which aim to serve as an evidence-based public health tool to guide Canadians towards safer consumption, similar to "Low Risk Drinking Guidelines" that have been used in alcohol public health initiatives.[15]

Originally published in 2011 and revised in 2017 in light of upcoming legalization, the LRCUG contain 10 recommendations on modifiable behavioural risk factors to reduce cannabis-associated harms.[15,16] They advise that the only way to completely avoid risk is to not consume the substance, and recommend that users avoid early initiation of cannabis, high-strength and synthetic products, smoking cannabis, deep inhalation, daily/near-daily use, and driving or operating machinery after consumption. They also advise against use in high-risk populations and combining risk behaviours addressed in these guidelines. The LRCUG have been endorsed by many national organizations including the Public Health Agency of Canada, Canadian Medical Association, and Mental Health Commission of Canada.[17] While these guidelines have been disseminated through knowledge translation materials such as brochures, posters and webinars since 2017, the effectiveness of these efforts remains unclear.

In response to an evolving body of scientific literature, the LRCUG were further updated in 2022.[8] Grading of evidence and guideline structure were updated, and several new recommendations were added, including encouraging the use of legal and quality-controlled cannabis products, recommending against vaping, and cautioning against combining other psychoactive substances with cannabis use. While these updated recommendations provide important context in the interpretation of our findings, this study is based on examining adherence to the 2017 guidelines using data collected from 2020 to 2022.

Several studies have examined adherence to the LRCUG in general Canadian and American population samples and found varying levels of compliance across the different recommendations. Among those who consumed cannabis, the most common high-risk behaviours were smoking cannabis, use of high-strength products, daily cannabis use, and driving under the influence.[18,19] While adherence to the 2017 guidelines has been examined in other studies, to our knowledge, no studies have examined adherence among university students. Due to their younger age, university students are particularly vulnerable to the adverse effects of cannabis and comprise a subpopulation where high-risk substance use behaviour is typically concentrated.[20,21] As such, public health efforts addressing cannabis use in university students offer an opportunity for early intervention and prevention of high-risk behaviours.

This study examines the adherence to seven of the ten 2017 Lower-Risk Cannabis Use Guideline recommendations among students from four Canadian universities and identifies the sociodemographic characteristics of high-risk users to inform future knowledge translation efforts.

Methods

Study design

The World Health Organization (WHO) World Mental Health-International College Student (WMH-ICS) initiative uses validated screening instruments to generate estimates for a range of substance use and mental disorders.[22] This study analyzed data collected through the repeated cross-sectional deployment of the WMH-ICS survey at four Canadian Universities: University of British Columbia (UBC), Simon Fraser University (SFU), McMaster University, and University of Toronto (UofT). The survey is based on the WHO World Mental Health-Composite International Diagnostic Interview (WHO WMH-CIDI).[23]

The survey is self-administered online using the Qualtrics survey platform.[24] It was sent via email to a new group of 350 students at each institution weekly. Groups were generated via stratified random sampling (by gender, age, degree type and year, and international student status), and a rigorous follow-up strategy was employed to minimize non-responder bias, per a specified protocol described in a previous paper.[25] This study contains 138 weeks of data dating from 9 February 2020, to 18 September 2022. Due to the staggered launch of the survey sites, data collection periods varied across sites. The survey's adjusted response rate was 43.5% using the American Association for Public Opinion research weighted response rate 1 (RR1w) calculation for two-phase sample designs.[26]

Outcome measures

In addition to the "abstain from use" recommendation, seven individual recommendations were operationalized: 1) having delayed cannabis use until at least the age of 16 years; 2) choose lower-strength cannabis products, such as those with a lower tetrahydrocannabinol (THC) content or a higher ratio of cannabidiol (CBD) to THC; 3) do not use synthetic cannabis products; 4) do not smoke cannabis; 5) do not inhale deeply or hold your breath when smoking cannabis; 6) if using cannabis, limit cannabis use to once a week or on weekends; and 7) do not drive a car or operate other machinery while under the influence (this assessment used the phrase "alcohol/other drug use" so was not specific to cannabis). As such, our outcome measures were lifetime cannabis use (representing the "abstain from use" recommendation) and the number of other unmet Canadian LRCUG recommendations. Of note, we assumed respondents who did not know the difference between THC and CBD did not choose lower-strength products, given most products on the market are high in THC. Based on the 2017 LRCUG, vaping was not categorized as smoking cannabis. The final recommendation to avoid combining high-risk behaviours was not operationalized as a separate guideline, since it was implicit in reporting the number of other unmet recommendations. The remaining guidelines were not operationalized. The cannabis survey questions are available upon request from the authors.

Ethics approval

All procedures contributing to this work comply with the ethical standards of the

relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects were approved by the Behavioural Research Ethics Board of the University of British Columbia (approval number H19-02538). Written informed consent was obtained from all participants before completing the WMH-ICS survey.

Statistical analyses

Descriptive statistics were used to characterize the sample and adherence to individual recommendations. Zero-inflated Poisson models were then employed to examine the sociodemographic correlates of 1) any lifetime recreational cannabis use; and 2) the number of LRCUG recommendations currently unmet, conditional on lifetime recreational cannabis use. The models consisted of 1) logistic regression predicting the odds of lifetime cannabis use; and 2) Poisson regression predicting the count of recommendations unmet. Logistic regression coefficients were exponentiated to obtain odds ratios and Poisson regression coefficients were exponentiated to obtain incidence rate ratios for the number of unmet recommendations among lifetime non-medical cannabis users. Incidence rate ratios represented the relative incidence of LRCUG recommendation non-adherence. Separate univariable models for each sociodemographic predictor were run, as well as one multivariable model with all predictors included. To address potential issues of homoscedasticity, the vce(robust) option was used to obtain robust standard errors. Analyses were conducted using the zip command in Stata.[27]

Next, separate multivariable binary logistic regression models were used to examine the sociodemographic correlates of adherence to each of the seven LRCUG recommendation variables evaluated. As with the zero-inflated Poisson models, the vce(robust) option was used, and separate univariable logistic regressions were run prior to the multivariable logistic regression. The gender variable was collapsed into three categories (cisgender man, cisgender woman, other) for these analyses to avoid complete separation due to small sample sizes in the other gender categories. Bonferroni correction was used to adjust for multiple comparisons.

The sociodemographic predictors included in each of the models were gender, sexual orientation, race and ethnicity, housing type, international student status, and age.

Since lifetime cannabis use measures were used, age effects could not be meaningfully interpreted; the higher rates of cannabis use in older students could be attributable to their use in previous years. Therefore, while age was included as a covariate to control for possible confounding, age trends were not reported.

All analyses were conducted using Stata Version 16.1 for Mac, with a significance level of 5% ($p < 0.05$).[27] Respondents with incomplete data were included in analyses if they had complete data for each of the outcome variables; missing values were categorized as "missing" for each covariate.

Results

The study sample comprised 27 236 respondents. The majority of the respondents were cisgender women (62.6%), and the average age was 21.9 years (range: 18–25 years). The sample was relatively ethnically diverse (35.1% White, 24.6% East Asian, 14.3% South Asian, 0.7% First Nations, Inuit, or Métis, and 25.3% other visible minority).

The characteristics of the study sample, stratified by lifetime non-medical cannabis use, are presented in Table 1. Overall, 33.8% of students indicated lifetime cannabis use. There were significant differences in all characteristics evaluated (gender, sexual orientation, race and ethnicity, student type, housing type, and student status).

Overall Lower-Risk Cannabis Use Guideline adherence

The adherence rate for each of the seven LRCUG recommendations is presented in Table 2. The prevalence of lifetime recreational cannabis use was 33.8%. Among those who had used cannabis (N = 9200), "choosing lower-strength cannabis products" had the lowest adherence rate (29.0%), followed by "not smoking cannabis" (36.7%). "Not using synthetic cannabis" had the highest adherence rate (96.1%), followed by "delaying cannabis use until age 16" (91.2%) and "not driving a car or operating other machinery after using alcohol or other drugs" (88.9%). Among students with lifetime non-medical cannabis use, the average number of recommendations met was 3.8 of the 7 evaluated.

Sociodemographic correlates of Lower-Risk Cannabis Use Guideline adherence

The results of the zero-inflated Poisson models evaluating the correlates of any lifetime cannabis use and the number of unmet LRCUG recommendations among lifetime users are presented in Table 3. The results of the logistic regression models evaluating the correlates of each individual LRCUG are presented in Table 4.

Gender

Compared to cisgender men, cisgender women had significantly lower odds of lifetime non-medical cannabis use (aOR = 0.82, 95% CI: 0.77–0.87) and, among cannabis users, a lower incidence of LRCUG recommendation non-adherence (aIRR = 0.86, 95% CI: 0.84–0.88). The largest disparities were in the odds "driving a car or operating machinery with cannabis use" (aOR = 0.5, 95% CI: 0.44–0.58) and "not limiting cannabis use" (aOR = 0.53, 95% CI: 0.47–0.58).

Sexual orientation

With the exception of asexual students, non-heterosexual students indicated significantly higher odds of lifetime non-medical cannabis use, with bisexual students reporting the highest odds (aOR = 3.02, 95% CI: 2.74–3.34). Conversely, asexual students reported significantly lower odds of lifetime non-medical cannabis use (aOR = 0.67, 95% CI: 0.51–0.88). Among lifetime cannabis users, bisexual students (aIRR = 1.08, 95% CI: 1.05–1.12) reported a higher incidence of LRCUG recommendation non-adherence than heterosexual students, though the effect was small. The extent of non-adherence of individual LRCUG recommendations was heterogeneous across non-heterosexual student groups, though highest in bisexual students across guidelines. In particular, bisexual students reported 3.01 times the odds of initiating cannabis use before the age of 16 (aOR = 3.01, 95% CI: 2.51–3.61).

Race and ethnicity

Racial and ethnic minority students reported lower odds of lifetime non-medical cannabis

TABLE 1
Sample characteristics, stratified by lifetime non-medical cannabis use, WMH-ICS survey (N = 27 236)

	No lifetime non-medical cannabis use N (row %)	Lifetime non-medical cannabis use N (row %)
Overall	18 036 (66.22%)	9 200 (33.78%)
Gender	*	*
Cisgender man	6 263 (66.83%)	3 108 (33.17%)
Cisgender woman	11 371 (66.76%)	5 661 (33.24%)
Transgender man	39 (53.42%)	34 (46.58%)
Transgender woman	28 (60.87%)	18 (39.13%)
Non-binary	223 (44.78%)	275 (55.22%)
Two-spirit	7 (38.89%)	11 (61.11%)
Other	87 (49.71%)	88 (50.29%)
Sexual orientation	*	*
Heterosexual	14 096 (70.02%)	6 036 (29.98%)
Gay or lesbian	498 (53.09%)	440 (46.91%)
Bisexual	1 205 (42.46%)	1 633 (57.54%)
Asexual	307 (77.72%)	88 (22.28%)
Questioning	893 (66.39%)	452 (33.61%)
Other	332 (51.00%)	319 (49.00%)
Race and ethnicity	*	*
White	4 588 (48.98%)	4 779 (51.02%)
First Nations, Inuit, or Métis	101 (52.33%)	92 (47.67%)
Hispanic or Latino	298 (60.20%)	197 (39.80%)
Black	371 (73.47%)	134 (26.53%)
Arab	364 (74.90%)	122 (25.10%)
East Asian (e.g. Chinese, Korean, Japanese)	5 573 (84.98%)	985 (15.02%)
Southeast Asian (e.g. Filipino, Vietnamese, Cambodian, Laotian, Thai)	570 (76.10%)	179 (23.90%)
South Asian (e.g. East Indian, Pakistani, Sri Lankan)	2 942 (77.12%)	873 (22.88%)
West Asian (e.g. Afghan, Iranian)	642 (76.34%)	199 (23.66%)
Other	497 (70.90%)	204 (29.10%)
Multiracial	1 688 (57.08%)	1 269 (42.92%)
Student type	*	*
Undergraduate	12 653 (68.70%)	5 765 (31.30%)
Graduate	4 095 (61.64%)	2 548 (38.36%)
Other	1 273 (58.99%)	885 (41.01%)
Housing type	*	*
With parents or other relatives	8 773 (72.58%)	3 315 (27.42%)
In their own home or apartment	4 493 (60.58%)	2 924 (39.42%)
In a university-owned or -operated residence or fraternity	1 760 (68.80%)	798 (31.20%)
In a shared house, apartment, or flat	2 754 (57.41%)	2 043 (42.59%)
Other	245 (67.49%)	118 (32.51%)
Student status	*	*
Domestic	14 549 (63.93%)	8 207 (36.07%)
International	3 487 (77.83%)	993 (22.17%)

Abbreviation: WMH-ICS, World Mental Health-International College Student.

Notes: Non-medical use is defined as use without a prescription or in larger doses than prescribed.

The extent of missing data varied across variables. Therefore, the Ns did not consistently sum to the total sample size of 8590 respondents.

Chi-square tests were conducted to test for differences in treatment rates across categories. All cell sizes were larger than 5.

*$p \leq 0.05$.

TABLE 2
Lifetime adherence rate for each of the evaluated Lower-Risk Cannabis Use Guidelines, among students reporting lifetime non-medical cannabis use, WMH-ICS survey (N = 9200)

Guideline	Adherence rate among non-medical cannabis users
Choosing lower-strength cannabis products	29.0%
Not smoking cannabis	36.7%
Never inhaling deeply or holding breath when smoking cannabis	64.2%
Limiting cannabis use as much as possible	78.2%
Not driving a car or operating other machinery after using alcohol or other drugs	88.9%
Delaying use of cannabis until age 16	91.2%
Not using synthetic cannabis	96.1%

Abbreviation: WMH-ICS, World Mental Health-International College Student.

use compared to White students, with East Asian students reporting the lowest odds of lifetime cannabis use (aOR = 0.19, 95% CI: 0.18–0.21), followed by West Asian (aOR = 0.36, 95% CI: 0.30–0.43), South Asian (aOR = 0.36, 95% CI: 0.33–0.40), and Southeast Asian (aOR = 0.38, 95% CI: 0.31–0.45) students. Conversely, among cannabis users, most racial and ethnic minority groups reported a higher incidence of LRCUG recommendation non-adherence, with First Nations, Inuit, and Métis students reporting the highest incidence of LRCUG recommendation non-adherence (aIRR = 1.14, 95% CI: 1.01–1.29), followed by Arab (aIRR = 1.11, 1.02–1.20) and West Asian (aIRR = 1.10, 95% CI: 1.03–1.17) students. East Asian students reported a lower incidence of LRCUG recommendation non-adherence among lifetime cannabis users, though the effect was small (aIRR = 0.97, 95% CI: 0.93–1.00). Compared with White students, First Nations, Inuit, or Métis students reported more than double the odds of initiating cannabis use before age 16 (aOR = 2.59, 95% CI: 1.65–4.07).

Housing

Students living on their own reported higher odds of lifetime non-medical cannabis use than students living with their parents or other relatives, with students living in a shared house, apartment, or flat (aOR = 1.82, 95% CI: 1.67–1.98) reporting the highest odds. In particular, students living in a shared house, apartment, or flat had 1.85 times the odds of smoking cannabis (aOR = 1.85, 95% CI: 1.69–2.03), compared to students living with family. Additionally, all groups of students living apart from their parents or other relatives reported higher odds of not meeting the "limiting cannabis use to once a week or weekends" recommendation, with the students living in a shared house, apartment, or flat reporting the highest odds of guideline non-adherence (1.69, 95% CI: 1.46–1.94).

International student status

International students reported significantly lower odds than domestic students (aOR = 0.54, 95% CI: 0.49–0.59) and a slightly lower incidence of LRCUG recommendation non-adherence among lifetime users (aIRR = 0.96, 95% CI: 0.93–1.00). International students reported the highest odds of following each of the individual recommendations, with the lowest comparative odds of inhaling deeply or holding their breath when smoking cannabis (aOR = 0.51, 95% CI: 0.44–0.58) and driving or operating other machinery while under the influence (aOR = 0.56, 95% CI: 0.44–0.71).

The results of the corresponding univariable, unadjusted analyses are available upon request from the authors.

Discussion

Key findings

This study evaluated the prevalence of cannabis use and adherence to LRCUG recommendations among university students, as well as the sociodemographic differences in LRCUG adherence. Optimistically, most students (66.2%) did not use cannabis, and among cannabis users, there were high rates of avoiding synthetic cannabis (96.1%), delaying cannabis use until age 16 (91.2%), not driving a car or operating other machinery after using alcohol or other drugs (88.9%), and limiting cannabis use as much as possible (78.2%). However, there were low rates of not smoking cannabis (36.7%) and choosing lower-strength cannabis products (29.0%) among users. The Canadian Postsecondary Education Alcohol and Drug Use Survey (CPADS) and Canadian Cannabis Survey (CCS) reported higher rates of cannabis use among students, with CPADS reporting a 12-month prevalence of 39.5% and CCS reporting a 12-month prevalence of 39.2%.[28,29] These differences may reflect the weighting of CPADS and CCS to reflect sex/age breakdowns, as well as the academic rigour of the Canadian universities surveyed in this study; research has shown that frequent cannabis use predicts a lower likelihood of postsecondary enrolment and degree attainment.[28,29] The patterns of guideline adherence among cannabis users generally align with those of the broader population; the 2018 International Cannabis Policy Study also reported smoking cannabis and use of high-strength cannabis as the guidelines most commonly unmet among Canadians and Americans aged 16 to 65.[18]

The low rates of choosing lower-strength cannabis products may be, in part, attributable to lack of knowledge. Among lifetime cannabis users in the study sample, 18.2% were aware of the existence of THC and CBD but not aware of their different properties and 2.7% were not aware of their existence altogether. Users with lesser knowledge about THC/CBD were significantly less likely to follow the "choosing lower-strength cannabis products" guideline. Similar findings have been reported among Canadian and American adults, with low proportions of 12-month cannabis users using products with equal or higher CBD levels, and a substantial proportion reporting that they did not know the relative levels in the products they typically used.[31] It is important to note the low availability of lower-potency cannabis products available; a 2022 analysis of Ontario Cannabis Store offerings found that the vast majority of inhalation products (94%–100%) had a high THC concentration.[32] These findings add to the mounting evidence highlighting the need for education conveying the nuances of lower-risk cannabis use, as well as availability of lower-risk cannabis products. Of note, Wood et al. recently proposed a simplified product labelling system based on "Canadian THC Units" that could be

TABLE 3
Multivariable adjusted odds ratios of lifetime non-medical cannabis use and multivariable adjusted incidence ratios for the number of unmet Lower-Risk Cannabis Use Guideline recommendations, WMH-ICS survey

	Part 1: Multivariable adjusted ORs of lifetime cannabis use N = 25 709	Part 2: Multivariable adjusted IRRs for the number of unmet lower-risk guideline recommendations N = 8934
Gender		
Cisgender man	Reference	Reference
Cisgender woman	0.82 (0.77–0.87)*	0.86 (0.84–0.88)*
Transgender man	0.65 (0.36–1.17)	0.92 (0.77–1.10)
Transgender woman	0.75 (0.31–1.83)	0.65 (0.49–0.87)*
Non-binary	1.10 (0.88–1.38)	0.95 (0.90–1.01)
Two-spirit	1.46 (0.46–4.59)	0.86 (0.61–1.21)
Other	0.93 (0.65–1.32)	0.93 (0.83–1.05)
Sexual orientation		
Heterosexual	Reference	Reference
Gay or lesbian	1.74 (1.49–2.02)*	1.01 (0.96–1.06)
Bisexual	3.02 (2.74–3.34)*	1.08 (1.05–1.12)*
Asexual	0.67 (0.51–0.88)*	0.90 (0.80–1.01)
Questioning	1.30 (1.14–1.48)*	1.03 (0.98–1.09)
Other	1.86 (1.53–2.25)*	1.05 (0.98–1.11)
Race and ethnicity		
White	Reference	Reference
First Nations, Inuit, or Métis	0.78 (0.57–1.06)	1.14 (1.01–1.29)*
Hispanic or Latino	0.78 (0.63–0.96)*	1.00 (0.93–1.08)
Black	0.41 (0.33–0.51)*	1.09 (1.01–1.17)*
Arab	0.40 (0.32–0.50)*	1.11 (1.02–1.20)*
East Asian (e.g. Chinese, Korean, Japanese)	0.19 (0.18–0.21)*	0.97 (0.93–1.00)*
Southeast Asian (e.g. Filipino, Vietnamese, Cambodian, Laotian, Thai)	0.38 (0.31–0.45)*	1.05 (0.98–1.13)
South Asian (e.g. East Indian, Pakistani, Sri Lankan)	0.36 (0.33–0.40)*	1.06 (1.02–1.10)*
West Asian (e.g. Afghan, Iranian)	0.36 (0.30–0.43)*	1.10 (1.03–1.17)*
Other	0.44 (0.37–0.53)*	0.95 (0.88–1.03)
Multiracial	0.76 (0.69–0.84)*	1.06 (1.03–1.10)*
Housing type		
With parents or other relatives	Reference	Reference
In their own home or apartment	1.39 (1.28–1.51)*	1.02 (0.99–1.05)
In a university-owned or -operated residence or fraternity	1.44 (1.29–1.61)*	1.00 (0.96–1.04)
In a shared house, apartment, or flat	1.82 (1.67–1.98)*	1.06 (1.03–1.09)*
Other	1.05 (0.81–1.36)	1.08 (0.98–1.20)
Student status		
Domestic	Reference	Reference
International	0.54 (0.49–0.59)*	0.96 (0.93–1.00)*

Abbreviations: IRRs, incidence rate ratios; LRCUG, Lower-Risk Cannabis Use Guideline; ORs, odds ratios; WMH-ICS, World Mental Health-International College Student.

Notes: Each of the multivariable adjusted odds ratios and multivariable adjusted risk differences are adjusted for all of the other predictors in the table, as well as age.

Incidence ratios for the number of unmet LRCUG were calculated among the sample of lifetime non-medical cannabis users.

* $p \leq 0.05$.

TABLE 4
Multivariable adjusted odds ratios of not meeting each of the seven Lower-Risk Cannabis Use recommendations evaluated, WMH-ICS survey

	Multivariable aOR of initiating cannabis use before age 16	Multivariable aOR of not choosing lower-strength cannabis products	Multivariable aOR of using synthetic cannabis products	Multivariable aOR of smoking cannabis	Multivariable aOR of inhaling deeply or holding one's breath when smoking cannabis	Multivariable aOR of not limiting cannabis use to once a week or on weekends	Multivariable aOR of driving a car or operating other machinery while under the influence of cannabis
Gender							
Cisgender man	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Cisgender woman	0.63 (0.54–0.74)*	0.69 (0.65–0.74)*	0.66 (0.53–0.83)*	0.74 (0.69–0.79)*	0.71 (0.65–0.77)*	0.53 (0.47–0.58)*	0.50 (0.44–0.58)*
Other (including transgender, non-binary, and two-spirit)	0.95 (0.69–1.30)	0.74 (0.62–0.88)*	0.70 (0.40–1.22)	0.92 (0.77–1.11)	0.95 (0.77–1.16)	0.90 (0.71–1.14)	0.67 (0.46–0.96)
Sexual orientation							
Heterosexual	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Gay or lesbian	1.25 (0.87–1.79)	1.53 (1.31–1.78)*	1.90 (1.20–3.02)*	1.45 (1.24–1.69)*	1.63 (1.36–1.95)*	1.37 (1.09–1.73)	0.97 (0.69–1.36)
Bisexual	3.01 (2.51–3.61)*	2.04 (1.87–2.24)*	2.33 (1.74–3.12)*	2.32 (2.11–2.54)*	2.44 (2.19–2.72)*	2.60 (2.28–2.96)*	1.72 (1.41–2.09)*
Asexual	1.16 (0.62–2.17)	0.61 (0.45–0.82)*	1.53 (0.67–3.5)	0.56 (0.41–0.76)*	0.72 (0.50–1.05)	0.45 (0.25–0.83)	0.80 (0.41–1.57)
Questioning	1.88 (1.4–2.52)*	1.20 (1.05–1.38)	1.30 (0.79–2.15)	1.11 (0.96–1.28)	1.28 (1.08–1.53)*	1.52 (1.22–1.89)*	1.43 (1.05–1.93)
Other	2.04 (1.41–2.95)*	1.52 (1.26–1.83)*	1.78 (0.98–3.21)	1.40 (1.15–1.70)*	1.63 (1.31–2.04)*	2.11 (1.63–2.74)*	1.55 (1.06–2.25)
Race and ethnicity							
White	Reference	Reference	Reference	Reference	Reference	Reference	Reference
First Nations, Inuit, or Métis	2.59 (1.65–4.07)*	0.79 (0.57–1.10)	1.07 (0.39–2.95)	1.00 (0.73–1.39)	1.11 (0.75–1.65)	1.47 (0.98–2.22)	0.98 (0.54–1.78)
Hispanic or Latino	0.65 (0.38–1.14)	0.97 (0.79–1.20)	0.74 (0.32–1.72)	0.94 (0.76–1.16)	0.91 (0.69–1.21)	0.74 (0.52–1.05)	0.66 (0.39–1.11)
Black	0.24 (0.10–0.57)*	0.66 (0.53–0.82)*	0.40 (0.13–1.28)	0.58 (0.46–0.74)*	0.88 (0.66–1.16)	0.67 (0.46–0.96)	0.53 (0.29–0.95)
Arab	0.53 (0.28–1.01)	0.6 (0.48–0.76)*	0.71 (0.29–1.77)	0.57 (0.45–0.73)*	0.70 (0.51–0.95)	0.96 (0.69–1.34)	0.39 (0.19–0.79)
East Asian (e.g. Chinese, Korean, Japanese)	0.25 (0.20–0.33)*	0.29 (0.26–0.32)*	0.50 (0.36–0.70)*	0.22 (0.20–0.25)*	0.29 (0.26–0.34)*	0.18 (0.15–0.22)*	0.52 (0.42–0.63)*
Southeast Asian (e.g. Filipino, Vietnamese, Cambodian, Laotian, Thai, etc.)	0.37 (0.20–0.67)*	0.57 (0.47–0.69)*	0.92 (0.48–1.76)	0.48 (0.39–0.59)*	0.61 (0.47–0.79)*	0.53 (0.38–0.75)*	0.61 (0.38–1.00)

Continued on the next page

TABLE 4 (continued)
Multivariable adjusted odds ratios of not meeting each of the seven Lower-Risk Cannabis Use recommendations evaluated, WMH-ICS survey

	Multivariable aOR of initiating cannabis use before age 16	Multivariable aOR of not choosing lower-strength cannabis products	Multivariable aOR of using synthetic cannabis products	Multivariable aOR of smoking cannabis	Multivariable aOR of inhaling deeply or holding one's breath when smoking cannabis	Multivariable aOR of not limiting cannabis use to once a week or on weekends	Multivariable aOR of driving a car or operating other machinery while under the influence of cannabis
South Asian (e.g. East Indian, Pakistani, Sri Lankan, etc.)	0.36 (0.27–0.48)*	0.51 (0.46–0.56)*	0.53 (0.35–0.81)*	0.53 (0.48–0.59)*	0.66 (0.58–0.75)*	0.51 (0.43–0.61)*	0.51 (0.40–0.66)*
West Asian (e.g. Afghan, Iranian, etc.)	0.32 (0.17–0.60)*	0.53 (0.44–0.64)*	0.80 (0.41–1.56)	0.59 (0.49–0.71)*	0.82 (0.65–1.04)	0.43 (0.3–0.61)*	0.53 (0.34–0.83)*
Other	0.48 (0.28–0.80)*	0.53 (0.44–0.65)*	0.44 (0.18–1.08)	0.54 (0.44–0.66)*	0.51 (0.39–0.68)*	0.65 (0.48–0.89)*	0.73 (0.48–1.10)
Multiracial	0.86 (0.7–1.07)	0.89 (0.81–0.98)	1.12 (0.81–1.53)	0.95 (0.86–1.04)	1.06 (0.94–1.19)	0.87 (0.75–1.01)	1.02 (0.83–1.25)
Housing type							
With parents or other relatives	Reference	Reference	Reference	Reference	Reference	Reference	Reference
In their own home or apartment	1.35 (1.09–1.66)*	1.27 (1.17–1.39)*	1.37 (1.00–1.89)	1.34 (1.23–1.47)*	1.22 (1.09–1.37)*	1.65 (1.43–1.90)*	1.11 (0.93–1.34)
In a university-owned or -operated residence or fraternity	1.15 (0.87–1.51)	1.38 (1.23–1.54)*	1.05 (0.69–1.61)	1.50 (1.34–1.69)*	1.34 (1.17–1.55)*	1.22 (1.00–1.48)	0.83 (0.61–1.13)
In a shared house, apartment, or flat	1.62 (1.32–1.99)*	1.63 (1.49–1.78)*	1.38 (1.01–1.89)	1.85 (1.69–2.03)*	1.66 (1.49–1.85)*	1.69 (1.46–1.94)*	1.20 (0.99–1.46)
Other	1.47 (0.82–2.62)	1.16 (0.90–1.51)	1.01 (0.37–2.72)	1.04 (0.78–1.39)	1.10 (0.78–1.55)	1.53 (1.03–2.28)	1.12 (0.65–1.93)
Student status							
Domestic	Reference	Reference	Reference	Reference	Reference	Reference	Reference
International	0.64 (0.5–0.84)*	0.64 (0.58–0.70)*	0.76 (0.53–1.09)	0.63 (0.57–0.69)*	0.51 (0.44–0.58)*	0.62 (0.53–0.74)*	0.56 (0.44–0.71)*

Abbreviations: aOR, adjusted odds ratio; WMH-ICS, World Mental Health-International College Student.

Notes: The adjusted odds ratios were calculated using multivariable logistic regression.

The multivariable adjusted odds ratios are adjusted for all of the other predictors in the table, as well as age.

* $p \leq 0.007$ ($p \leq 0.05$ after Bonferroni correction).

integrated into future LRCUG guidelines and cannabis product labels to enable cannabis users to more easily and accurately assess their THC dosing levels across different product types and modes of administration.[33]

Men, non-heterosexual students, students living in shared housing, and domestic students were more likely to use cannabis and, among users, reported riskier use. White students were most likely to use cannabis; however, among users, non-White student groups (with the exception of East Asian and "other" students), reported riskier use. These findings generally align with the literature. For example, the more common, intensive, and riskier use in men has been well documented and may be shaped by gender norms.[34] Additionally, the CCS also reported a high prevalence of cannabis use in sexual and gender minority (SGM) individuals, which is posited to arise from its role in coping with societal stressors and the openness in SGM communities.[29,35] The CPADS also reported the highest rates of cannabis use in Indigenous, multiracial, and White post-secondary students.[28] Interestingly, among American youth, Black, Indigenous, Hispanic and Asian American past-year users reported higher odds of cannabis use disorder than their White counterparts, further confirming the trend in our data and highlighting the importance of targeting the subpopulation of racial/ethnic minority users.[36]

Strengths and limitations

There are several key strengths and limitations of this study. This appears to be the first study of adherence to LRCUG recommendations among university students in Canada. Understanding rates of adherence to LRCUG recommendations and associated sociodemographic correlates in this population provides important insights to inform targeted intervention and prevention initiatives in a population where both cannabis use and hazardous cannabis use are common.[30] A major methodological strength of the repeated cross-sectional survey design was the use of weekly stratified random sampling (by gender, age, degree type and year, and international student status) to recruit a large sample of students. Additionally, efforts were made to reduce non-responder bias through use of a multistage recruitment strategy.[25] There are also several limitations to be considered. Firstly, while our stratified random sampling strategy provided a representative sample of survey invitees, our sample was not weighted to improve representativeness of respondents. Additionally, the assessment of cannabis use was limited to any lifetime use which prevented the assessment of both frequency and recency of use. For some, "lifetime use" may simply represent one-time use. Further, our study examined adherence to the 2017 LRCUG as opposed to the most updated 2022 version, since our data was collected from 2020 to 2022. While the 2017 LRCUG remain cited by Health Canada and largely overlap with the 2022 LRCUG, one key recommendation we did not evaluate was the avoidance of vaping.[17] The 2022 LRCUG acknowledge that vaping has a lower level of toxin exposure than smoking, but emphasize that it still carries the risks associated with cannabis inhalation and potential exposure to other contaminants, making it an important behaviour for future study.[8] Lastly, the generalizability of the results of this study is limited by the four universities from which students were recruited; the sample does not include data from the numerous colleges and smaller universities across Canada which have been shown to have higher rates of cannabis use than those found in this study.

Conclusion

To our knowledge, this is the first study to examine adherence to the LRCUG recommendations among Canadian university students—a distinct population with opportunities for targeted public health initiatives. While our findings reveal several encouraging patterns of harm reduction, they also highlight critical gaps in LRCUG recommendation adherence, particularly regarding methods of consumption and cannabis product potency. Although some of these behaviours may reflect personal preference, our study indicates that significant knowledge gaps persist. Future interventions should aim to directly address these gaps. In the university setting, this could include orientation events, campus posters, and messaging through student health and wellness services. Campus residences, with their centralized structure and built-in communication networks, also offer an ideal environment for knowledge translation. Adoption of a standard THC unit on cannabis labels and increased availability of lower-potency cannabis products is also needed to facilitate low-risk use.

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Conflict of interest

None to declare.

Authors' contributions and statement

J.P., L.J., C.R., R.M. and D.V. conceptualized the study.

J.P., C.R., and R.M. conducted the data curation and formal analysis.

L.J., K.H., A.W. and L.M. conducted the project administration.

J.P., L.J. and C.R. wrote the original draft.

All authors reviewed and edited the manuscript. All authors approved the final version of the article.

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Original quantitative research

Concurrent mental health and substance use disorders among Canadian adults during the COVID-19 pandemic: a population-based study

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This article has been peer reviewed.

Abstract

Introduction: Concurrent disorders, defined here as co-occurring mental health disorders (MHD) and substance use disorders (SUD), pose challenges for treatment and public health. This study examines the prevalence and characteristics associated with MHD only, SUD only, and concurrent disorders among Canadians aged 15 and older during the COVID-19 pandemic.

Methods: We analyzed data from the 2022 Mental Health and Access to Care Survey (MHACS), a cross-sectional survey of Canadians aged 15 and older living in the 10 provinces (n = 9861). MHD and SUD were assessed using the WHO Composite International Diagnostic Interview. Respondents were classified into four groups: no disorder, MHD only, SUD only, and concurrent disorders. Multinomial logistic regression identified sociodemographic, health, and pandemic-related characteristics associated with these disorder categories, using survey weights and bootstrap methods.

Results: Among respondents, 1.6% had concurrent disorders, 12.2% had a MHD only, and 1.6% had a SUD only. Younger adults, especially those aged 20 to 24, and 2SLGBTQI+ individuals had elevated risk for concurrent disorders. Additional correlates included lower education, rural residence, weak sense of belonging, and functional impairment. Pandemic-related stressors—loneliness, financial hardship, and difficulty accessing care—were strongly associated with concurrent disorders.

Conclusion: This study highlights the prevalence and key correlates for MHD, SUD, and concurrent disorders among Canadian adults during the COVID-19 pandemic. Vulnerable populations include younger individuals, sexual and gender minorities, and those facing social isolation or unmet care needs. These findings underscore the importance of ensuring integrated, accessible mental health and substance use services in Canada's postpandemic recovery.

Keywords: *concurrent disorders, mental health disorders, substance use disorders, COVID-19 pandemic*

Highlights

- The co-occurrence of mental health and substance use disorders (concurrent disorders) rose from 1.2% in 2012 to 1.6% in 2022.
- The prevalence of mental health disorders alone nearly doubled, from 6.1% in 2012 to 12.2% in 2022, while substance use disorders alone declined from 3.8% to 1.6%.
- Concurrent disorders are most common among young adults (20–24 years), 2SLGBTQI+ individuals, and those with a weak sense of social belonging.
- People in rural areas, those with lower education, and those facing unmet care needs had higher rates of these disorders.
- Pandemic-related stressors, such as loneliness and financial hardship, were strongly linked to the risk of all disorders.

Introduction

Mental health disorders (MHD) and substance use disorders (SUD) are among the most pressing and interconnected public health challenges worldwide.[1,2] These often chronic conditions contribute substantially to disability, reduced productivity, and mortality.[1,3] In Canada, nearly one in three people have met the criteria for at least one selected MHD and SUD in their lifetime.[4]

Of particular concern is the frequent co-occurrence of MHD and SUD, often referred to as concurrent disorders or dual diagnoses,[5] with an estimated past 12-month prevalence of approximately 1.2% based on 2012 Canadian Community Health Survey data.[6] Concurrent disorders are associated with more severe clinical symptoms, poorer social outcomes, and greater barriers to care.[7-9] The concurrent disorders

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are believed to result from a complex interplay of shared risk factors and bidirectional causal relationships. These include early-life adversities such as trauma and abuse,[10,11] chronic stress exposure,[12] genetic vulnerability,[13] and overlapping neurobiological pathways.[14] Individuals with untreated depression or anxiety may turn to substance use as a form of self-medication, while prolonged substance use can in turn exacerbate or precipitate mental illness.[14-18] These mechanisms often result in a reinforcing cycle of worsening symptoms, higher rates of emergency care use, and lower treatment retention when care is fragmented.[9,19,20]

Despite the well-recognized clinical significance of concurrent disorders, most epidemiologic research has historically examined MHD and SUD as separate conditions, limiting our understanding of their overlap in population settings. Much of the existing literature is based on clinical or treatment-seeking samples,[21,22] which may not reflect the full range of disease burden in the general population. While some studies on concurrent disorders exist, many focus on specific subgroups such as adolescents, clinical populations, or individuals who are homeless or marginally housed.[23-25] In Canada, most population-level research relies on survey data collected over a decade ago,[6,8] which may not reflect current trends or the evolving landscape of concurrent disorders. There is a critical need for up-to-date, population-based studies to better understand the concurrent disorders and to inform effective public health planning.

Crucially, understanding this evolving landscape requires examining how social and structural determinants shaped these co-occurring conditions.[26-28] Emerging evidence shows that the COVID-19 pandemic was associated with increased symptoms of depression and anxiety, loneliness and social isolation, financial hardship, and disruptions in access to mental health and addiction services.[29-31] These stressors and service disruptions likely amplified pre-existing vulnerabilities and interacted with them, contributing to complex and heterogeneous patterns of MHD and SUD during this period. However, most pandemic-era studies have examined MHD and SUD separately, with relatively little population-based evidence on their co-occurrence.[22,29-36]

To address these gaps, we used data from the Mental Health and Access to Care Survey (MHACS),[37] a population-based survey conducted in 2022 that included Canadians aged 15 and older living in the 10 provinces. Collected in the later phase of the COVID-19 pandemic, these data provide a snapshot of the burden of MHD, SUD, and their co-occurrence during a period of ongoing social disruption and health system strain.

Methods

Study design and data source

This study analyzed data from the Public Use Microdata File (PUMF) of MHACS, a cross-sectional survey conducted by Statistics Canada between 17 March and 31 July 2022.[37] The target population included individuals aged 15 and older living in the 10 Canadian provinces, excluding those living on reserves, full-time members of the Canadian Forces, and residents of collective dwellings (e.g. institutions). The MHACS was designed to assess mental health and access to care in the context of the COVID-19 pandemic, capturing detailed information on psychological symptoms, service use, and sociodemographic characteristics. The MHACS sample was drawn from respondents to the 2021 long-form Census. Of the 39 485 households invited, 9861 completed the survey, yielding a response rate of 25%. To ensure representativeness of the household population in the provinces, Statistics Canada applied sampling weights that account for the survey's complex design and non-response.

Study variables and measures

Outcome variable

MHDs and SUDs were assessed using the Canadian adaptation of the World Health Organization Composite International Diagnostic Interview (WHO-CIDI),[38] a standardized and widely validated diagnostic tool designed for epidemiological research. Administered by trained interviewers, the WHO-CIDI applies diagnostic criteria from the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) and the *International Classification of Diseases* (ICD) to identify psychiatric conditions.

This study focused on past-year diagnoses (within 12 months of the survey) to capture the period most affected by the COVID-19 pandemic. MHDs were defined as mood and/or anxiety disorders (e.g. major depressive episode, bipolar I/II, hypomania, generalized anxiety disorder, social phobia). SUDs included alcohol or drug abuse/dependence. Each was coded as present versus not present, and respondents were classified as:

- No disorder: No past-year MHD or SUD
- MHD only: One or more MHD, but no SUD in the past year
- SUD only: One or more SUD, but no MHD in the past year
- Concurrent disorders: At least one MHD and at least one SUD in the past year.

Covariates

We included a broad set of covariates to explore individual, social, and contextual factors associated with disorder status, grouped as follows:

Demographic and socioeconomic characteristics

- Age: 15 to 19, 20 to 24, 25 to 29, 30 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 and older.
- Gender: Men+ and Women+, based on the Statistics Canada-derived gender variable. In the MHACS, records for non-binary respondents are randomly allocated to these two categories for confidentiality; disaggregated non-binary data are not available.
- 2SLGBTQI+ status: Classified as 2SLGBTQI+ vs. non-2SLGBTQI+.
- Marital status: Married or living common-law; never married; separated, divorced or widowed.
- Education level: Less than high school; high school; trades or college or university below bachelor's; bachelor's or higher.
- Household income: Low (< $30 000), middle ($30 000–99 999), high (≥ $100 000).
- Place of residence (based on population size): rural (< 1000), small (1000–29 999), medium (30 000–99 999), and large (≥ 100 000).

Psychosocial factors

- Sense of social belonging: Very strong, somewhat strong, somewhat weak, very weak.

Health status and perceived needs

- Functional impairment: Measured via the World Health Organization Disability

Assessment Schedule (WHODAS) 2.0,[39] which evaluates limitations across six domains (mobility, self-care, social participation, etc.). Scores range from 0 to 40, with higher scores indicating more impairment.

- Perceived need for mental health care in the past year: Respondents were classified into the following four mutually exclusive categories.
  - No perceived need: Did not feel a need and did not receive care
  - All needs met: Needed care and received it fully
  - Partially met needs: Received some care but felt it was insufficient
  - Unmet needs: Felt a need but received no care.

COVID-19-related stressors

Three binary variables captured pandemic-specific stressors. Respondents were asked whether, due to the COVID-19 pandemic, they had: (1) experienced financial difficulties (financial impact: yes vs. no); (2) had difficulty accessing needed mental health care (access barriers: yes vs. no); and (3) felt lonely or isolated as a result of the pandemic (loneliness: yes vs. no).

Statistical analysis

Descriptive statistics were used to summarize the sample characteristics overall and by MHD and SUD categories. Continuous variables were presented as medians with interquartile ranges. Categorical variables were summarized using frequencies and weighted percentages.

Multinomial logistic regression was used to compare three diagnostic groups (MHD only, SUD only, concurrent disorders) against a reference group of no disorder. To further differentiate concurrent disorders from single disorders, we refit the models using MHD only and SUD only as alternative reference groups. This strategy distinguishes correlates associated with any disorder (relative to no disorder) from those more specific to concurrent disorders (relative to MHD only or SUD only). Univariate models were fitted for each covariate, followed by a multivariable model including all covariates. Relative risk ratios (RRRs) and adjusted RRRs (aRRRs), along with their 95% confidence intervals (CIs), were reported.

All analyses were conducted in Stata version 18 (StataCorp LLC, College Station, TX, USA). Person-level survey weights were applied to obtain population-representative estimates. Variance estimation and 95% CIs used the bootstrap replicate weights provided by the MHACS, implemented with Stata's survey procedures for bootstrap replicate designs, which account for the complex sampling design.

Ethics approval

This study utilized publicly available, de-identified secondary data from the MHACS. According to the Tri-Council Policy Statement (TCPS 2), research using anonymized, publicly accessible secondary data is exempt from institutional ethics review.

Results

Table 1 summarizes participant characteristics by diagnostic category. Most respondents (84.6%) reported no past-year MHD or SUD, while 12.2% had MHD only, 1.6% had SUD only, and 1.6% had concurrent disorders. Concurrent disorders were most prevalent among adults aged 20 to 24 (6.2%) and 2SLGBTQI+ respondents (8.3%), and were more common among individuals who were never married, those with lower educational attainment, and those living in rural areas. Higher prevalence of concurrent disorders was also observed among participants reporting weaker social belonging, chronic physical conditions, greater functional impairment, and unmet mental health care needs. Pandemic-related stressors, including loneliness, financial strain, and access barriers, were reported more often among individuals with concurrent disorders.

Table S1 (supplementary materials available at https://osf.io/h9uqb/) presents unadjusted RRRs from univariate multinomial regression. Younger age, 2SLGBTQI+ identity, never married status, lower income and education, rural residence, weaker social belonging, greater disability, unmet mental health care needs, and pandemic-related stressors were all associated with higher risk of concurrent disorders.

Table 2 presents aRRRs from the multivariable multinomial models. Figure 1 displays aRRRs for each disorder category using "no disorder" as the reference group, and Figure S1 (supplementary materials at https://osf.io/h9uqb/) presents aRRRs for models using "MHD only" and "SUD only" as alternative reference groups. Younger age was consistently associated with a higher risk of all disorder categories relative to older adults (65+). The risk of concurrent disorders was particularly elevated among individuals aged 20 to 24 (aRRR = 32.48; 95% CI: 20.73–50.91). Compared to those with MHD only, this age group had nearly six times higher risk of concurrent disorders (aRRR = 5.99). Compared to those with SUD only, the risk of concurrent disorders was also substantially higher among young adults, especially those aged 25 to 29 (aRRR = 16.99) and 20 to 24 (aRRR = 9.38), highlighting early adulthood as a critical period for co-occurrence.

Men were less likely to report MHD only (aRRR = 0.64) but more likely to report SUD only (aRRR = 3.40) versus no disorder. Compared with MHD only, men had higher risk of concurrent disorders (aRRR = 1.59), but lower risk compared to SUD only (aRRR = 0.30), suggesting SUD often occurs alone among men. 2SLGBTQI+ individuals had greater risk of concurrent disorders relative to those with no disorder (aRRR = 1.67) compared with non-2SLGBTQI+ individuals, and also had elevated risk of concurrent disorders relative to MHD only (aRRR = 1.44) and SUD only (aRRR = 1.89). Compared with those who were married or living common-law, individuals who had never been married or were separated, divorced or widowed were at increased risk of SUD only and concurrent disorders relative to no disorder. These groups also showed elevated risk of concurrent disorders relative to MHD only (aRRRs = 1.58 and 2.50, respectively), though not significantly different from SUD only.

Higher education was a strong protective factor: respondents with a bachelor's degree or higher had reduced risks of all disorder types and were less likely to report concurrent disorders relative to MHD only (aRRR = 0.40) or SUD only (aRRR = 0.47). Middle and high income were associated with higher risk of SUD only compared to no disorder, but high income was inversely associated with concurrent disorders relative to both MHD only (aRRR = 0.58) and SUD only (aRRR = 0.45).

Place of residence showed complex associations. Compared to residents of large

TABLE 1
Participant characteristics stratified by diagnostic category, MHACS, 2022

Variable	Category	No disorder (n = 7236) n (%)	MHD only (n = 1043) n (%)	SUD only (n = 133) n (%)	Concurrent (n = 137) n (%)	Total (n = 8549) n (%)
Demographic and socioeconomic characteristics						
Age group (n = 8549)	15–19	584 (70.0%)	188 (24.3%)	12 (2.0%)	18 (3.8%)	802
	20–24	687 (66.9%)	242 (22.3%)	38 (4.7%)	51 (6.2%)	1 018
	25–29	362 (73.0%)	105 (20.9%)	8 (1.7%)	18 (4.4%)	493
	30–34	472 (76.3%)	83 (16.3%)	14 (4.1%)	13 (3.3%)	582
	35–44	1 042 (81.9%)	134 (14.2%)	18 (1.9%)	18 (2.1%)	1 212
	45–54	926 (84.5%)	111 (12.4%)	15 (2.0%)	9 (1.1%)	1 061
	55–64	1 028 (89.7%)	95 (9.0%)	8 (0.7%)	6 (0.6%)	1 137
	65+	2 135 (94.4%)	85 (4.5%)	20 (0.9%)	4 (0.2%)	2 244
Gender (n = 8536)	Women+	3 449 (79.9%)	690 (16.9%)	36 (1.1%)	66 (2.1%)	4 241
	Men+	3 776 (86.4%)	351 (9.0%)	97 (2.7%)	71 (2.0%)	4 295
2SLGBTQI+ (n = 8307)	No	6 731 (85.0%)	844 (11.6%)	118 (1.8%)	96 (1.6%)	7 789
	Yes	297 (56.1%)	170 (33.2%)	12 (2.4%)	39 (8.3%)	518
Marital status (n = 8508)	Married or living common law	4 248 (88.4%)	345 (9.6%)	48 (1.2%)	27 (0.8%)	4 668
	Never married	2 054 (72.4%)	594 (20.3%)	72 (3.1%)	95 (4.2%)	2 815
	Separated, divorced or widowed	904 (85.1%)	97 (11.1%)	11 (1.8%)	13 (2.0%)	1 025
Education (n = 8360)	Less than high school	617 (78.7%)	125 (15.9%)	10 (2.1%)	15 (3.3%)	767
	High school	1 545 (79.2%)	310 (15.5%)	42 (2.5%)	55 (2.8%)	1 952
	Trade, college or university below bachelor	2 132 (83.7%)	281 (12.4%)	45 (1.9%)	40 (1.9%)	2 498
	Bachelor's degree or higher	2 776 (86.9%)	310 (10.9%)	32 (1.2%)	25 (1.0%)	3 143
Household income (n = 8497)	Low income	467 (79.8%)	71 (15.9%)	10 (1.8%)	9 (2.5%)	557
	Middle income	2 804 (83.8%)	348 (11.8%)	47 (1.9%)	57 (2.5%)	3 256
	High income	3 922 (82.9%)	615 (13.6%)	76 (1.9%)	71 (1.6%)	4 684
Place of residence (n = 8549)	Rural (< 1000)	954 (84.0%)	121 (11.2%)	26 (2.5%)	20 (2.3%)	1 121
	Small (1000–29 999)	627 (80.3%)	101 (15.1%)	12 (1.9%)	17 (2.6%)	757
	Medium (30 000–99 999)	517 (83.9%)	77 (13.1%)	9 (1.6%)	9 (1.4%)	612
	Large (≥ 100 000)	5 138 (83.2%)	744 (13.1%)	86 (1.7%)	91 (1.9%)	6 059
Psychosocial factors						
Sense of belonging (n = 8362)	Very strong	1 326 (92.7%)	73 (5.5%)	13 (1.5%)	4 (0.4%)	1 416
	Somewhat strong	3 554 (87.2%)	387 (9.7%)	63 (1.8%)	45 (1.2%)	4 049
	Somewhat weak	1 720 (75.7%)	393 (19.0%)	40 (1.9%)	58 (3.4%)	2 211
	Very weak	473 (65.9%)	168 (26.0%)	16 (3.0%)	29 (5.1%)	686

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TABLE 1 (continued)
Participant characteristics stratified by diagnostic category, MHACS, 2022

Variable	Category	No disorder (n = 7236) n (%)	MHD only (n = 1043) n (%)	SUD only (n = 133) n (%)	Concurrent (n = 137) n (%)	Total (n = 8549) n (%)
Health status and perceived needs						
Functional impairment (n = 8217)	WHO disability score	0 (6)	11 (19)	3 (11)	14 (19)	3 (8)
Perceived needs (n = 8301)	No perceived need for mental health	5 998 (93.2%)	305 (4.8%)	78 (1.4%)	27 (0.5%)	6 408
	All needs met	674 (63.5%)	308 (28.9%)	27 (3.0%)	42 (4.6%)	1 051
	Partially met	189 (38.5%)	249 (50.4%)	16 (3.3%)	34 (7.9%)	488
	Not met	202 (56.5%)	126 (34.4%)	7 (2.8%)	19 (6.3%)	354
COVID-19-related stressors						
Financial impact (n = 8487)	No	5 751 (85.9%)	706 (11.2%)	81 (1.5%)	69 (1.4%)	6 607
	Yes	1 434 (74.0%)	329 (18.8%)	49 (3.0%)	68 (4.1%)	1 880
Access barriers (n = 8487)	No	6 017 (85.3%)	744 (11.2%)	106 (2.0%)	80 (1.5%)	6 947
	Yes	1 168 (74.2%)	291 (20.3%)	24 (1.4%)	57 (4.1%)	1 540
Loneliness (n = 8487)	No	4 177 (92.8%)	215 (5.4%)	40 (1.2%)	18 (0.6%)	4 450
	Yes	3 008 (73.0%)	820 (20.9%)	90 (2.5%)	119 (3.5%)	4 037

Abbreviations: MHACS, Mental Health and Access to Care Survey; MHD, mental health disorders; pop, population; SUD, substance use disorders; WHO, World Health Organization.
Notes: Values are presented as counts (percentages) unless otherwise noted.
WHO disability score (WHODAS 2.0)[38] is presented as median (interquartile range).

TABLE 2
Adjusted relative risk ratios (aRRRs) from multivariable multinomial logistic regression models assessing associations between covariates and three disorder categories: MHD only, SUD only, and concurrent disorders, MHACS, 2022

Variable	Category	MHD only vs. no disorder aRRR (95% CI)	SUD only vs. no disorder aRRR (95% CI)	Concurrent vs. no disorder aRRR (95% CI)	Concurrent vs. MHD only aRRR (95% CI)	Concurrent vs. SUD only aRRR (95% CI)
Demographic and socioeconomic characteristics						
Age (ref.: 65+)	15–19	5.24 (4.34–6.32)***	1.41 (1.01–1.97)*	10.00 (6.11–16.37)***	1.91 (1.15–3.17)**	7.11 (3.96–12.77)***
	20–24	5.42 (4.57–6.43)***	3.46 (2.48–4.84)***	32.48 (20.73–50.91)***	5.99 (3.78–9.49)***	9.38 (5.42–16.23)***
	25–29	5.05 (4.25–5.99)***	1.19 (0.78–1.80)	22.08 (14.11–34.55)***	3.99 (2.51–6.34)***	16.99 (9.31–31.00)***
	30–34	4.23 (3.59–4.98)***	4.62 (3.27–6.51)***	18.42 (11.60–29.23)***	4.36 (2.72–6.99)***	3.99 (2.27–7.00)***
	35–44	3.19 (2.76–3.69)***	1.36 (1.00–1.84)*	10.08 (6.62–15.35)***	3.16 (2.05–4.87)***	7.42 (4.47–12.31)***
	45–54	2.86 (2.47–3.32)***	2.39 (1.77–3.22)***	5.30 (3.35–8.40)***	1.85 (1.16–2.97)**	2.22 (1.29–3.84)***
	55–64	1.84 (1.59–2.13)***	0.50 (0.34–0.74)***	1.83 (1.12–3.00)*	1.00 (0.60–1.65)	3.63 (1.98–6.66)***
Gender (ref.: Women+)	Men+	0.64 (0.59–0.68)***	3.40 (2.89–4.01)***	1.01 (0.85–1.19)	1.59 (1.34–1.88)***	0.30 (0.24–0.37)***
2SLGBTQI+ (ref.: No)	Yes	1.16 (1.03–1.31)*	0.88 (0.69–1.13)	1.67 (1.37–2.03)***	1.44 (1.19–1.74)***	1.89 (1.40–2.55)***

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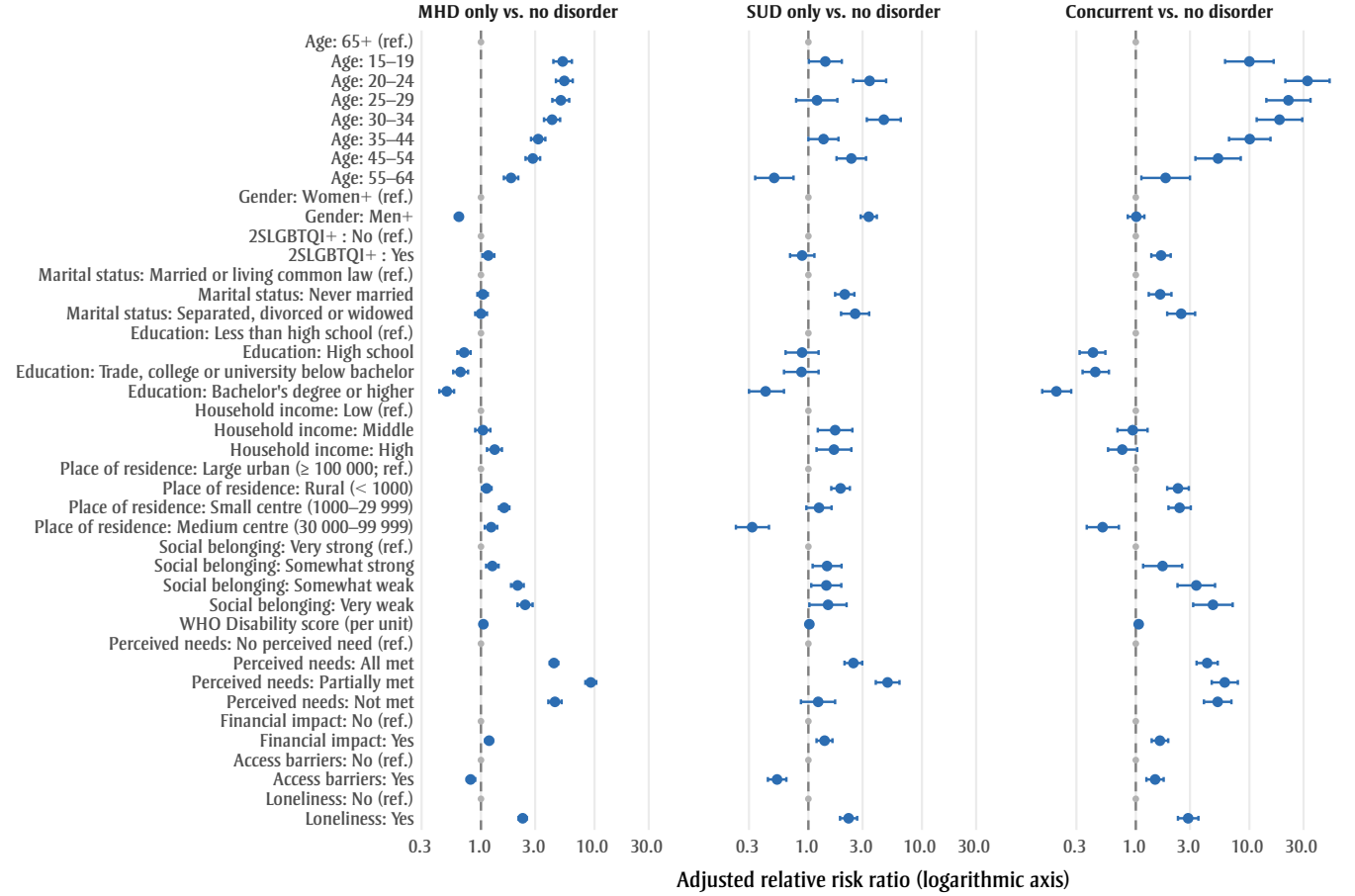
TABLE 2 (continued)
Adjusted relative risk ratios (aRRRs) from multivariable multinomial logistic regression models assessing associations between covariates and three disorder categories: MHD only, SUD only, and concurrent disorders, MHACS, 2022

Variable	Category	MHD only vs. no disorder	SUD only vs. no disorder	Concurrent vs. no disorder	Concurrent vs. MHD only	Concurrent vs. SUD only
		aRRR (95% CI)	aRRR (95% CI)	aRRR (95% CI)	aRRR (95% CI)	aRRR (95% CI)
Marital status (ref.: Married or living common law)	Never married	1.04 (0.93–1.15)	2.09 (1.72–2.54)***	1.64 (1.30–2.06)***	1.58 (1.26–1.99)***	0.78 (0.58–1.05)
	Separated, divorced or widowed	1.00 (0.89–1.13)	2.58 (1.94–3.43)***	2.51 (1.89–3.33)***	2.50 (1.89–3.31)***	0.97 (0.66–1.44)
Education (ref.: Less than high school)	High school	0.71 (0.62–0.81)***	0.88 (0.63–1.23)	0.42 (0.32–0.54)***	0.59 (0.45–0.77)***	0.47 (0.32–0.71)***
	Trade, college, or university below bachelor	0.66 (0.57–0.77)***	0.87 (0.61–1.23)	0.44 (0.34–0.58)***	0.67 (0.50–0.90)**	0.51 (0.33–0.78)***
	Bachelor's degree or higher	0.50 (0.43–0.58)***	0.42 (0.30–0.61)***	0.20 (0.15–0.27)***	0.40 (0.30–0.55)***	0.47 (0.30–0.74)***
Household income (ref.: Low)	Middle	1.04 (0.89–1.21)	1.72 (1.21–2.44)**	0.94 (0.69–1.27)	0.90 (0.66–1.23)	0.55 (0.35–0.86)**
	High	1.32 (1.13–1.53)***	1.68 (1.18–2.39)**	0.76 (0.57–1.03)	0.58 (0.42–0.79)***	0.45 (0.29–0.72)***
Place of residence (ref.: Large [≥ 100 000])	Rural (< 1000)	1.12 (1.02–1.24)*	1.92 (1.59–2.32)***	2.35 (1.89–2.93)***	2.09 (1.68–2.61)***	1.22 (0.92–1.63)
	Small (1000–29 999)	1.60 (1.44–1.78)***	1.24 (0.96–1.60)	2.43 (1.94–3.05)***	1.52 (1.21–1.91)***	1.96 (1.41–2.74)***
	Medium (30 000–99 999)	1.23 (1.08–1.39)**	0.32 (0.23–0.45)***	0.51 (0.37–0.71)***	0.42 (0.30–0.58)***	1.60 (1.01–2.54)**
Psychosocial factors						
Social belonging (ref.: Very strong)	Somewhat strong	1.26 (1.11–1.43)***	1.46 (1.09–1.96)*	1.72 (1.16–2.56)**	1.37 (0.92–2.04)	1.18 (0.72–1.92)
	Somewhat weak	2.10 (1.84–2.38)***	1.44 (1.06–1.95)*	3.41 (2.33–4.99)***	1.63 (1.11–2.38)**	2.37 (1.46–3.87)***
	Very weak	2.45 (2.10–2.85)***	1.49 (1.02–2.17)*	4.78 (3.20–7.13)***	1.95 (1.32–2.89)***	3.20 (1.88–5.46)***
Health status and perceived needs						
Functional impairment	WHO disability score	1.05 (1.05–1.06)***	1.02 (1.01–1.03)***	1.06 (1.06–1.07)***	1.01 (1.00–1.02)**	1.04 (1.03–1.05)***
Perceived needs (ref.: No perceived need)	All met	4.39 (4.03–4.79)***	2.49 (2.08–2.98)***	4.25 (3.43–5.27)***	0.97 (0.77–1.21)	1.71 (1.30–2.24)***
	Partially met	9.27 (8.30–10.36)***	4.98 (3.92–6.34)***	6.07 (4.66–7.92)***	0.66 (0.50–0.86)***	1.22 (0.87–1.70)
	Not met	4.48 (3.92–5.13)***	1.22 (0.86–1.72)	5.26 (3.98–6.95)***	1.17 (0.88–1.56)	4.32 (2.82–6.61)***
COVID-19-related stressors						
Financial impact (ref.: No)	Yes	1.18 (1.09–1.27)***	1.39 (1.18–1.63)***	1.63 (1.38–1.93)***	1.38 (1.17–1.64)***	1.18 (0.94–1.48)
Access barriers (ref.: No)	Yes	0.81 (0.75–0.89)***	0.53 (0.44–0.64)***	1.48 (1.24–1.76)***	1.81 (1.52–2.16)***	2.77 (2.17–3.52)***
Loneliness (ref.: No)	Yes	2.33 (2.14–2.53)***	2.26 (1.90–2.69)***	2.89 (2.35–3.56)***	1.24 (0.99–1.56)	1.28 (0.98–1.67)

Abbreviations: aRRR, adjusted relative risk ratio; CIs, confidence intervals; MHACS, Mental Health and Access to Care Survey; MHD, mental health disorders; pop, population; ref., referent; SUD, substance use disorders; WHO, World Health Organization.
Note: Models used different reference groups—no disorder, MHD only, and SUD only—to specifically compare concurrent disorders against each category (MHACS sample: n = 7447).
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

FIGURE 1
Adjusted relative risk ratios (aRRRs) and 95% CIs from multivariable multinomial logistic regression models comparing MHD only, SUD only, and concurrent disorders to the reference category of no disorder (MHACS, 2022; n = 7447)



Abbreviations: CIs, confidence intervals; MHACS, Mental Health and Access to Care Survey; MHD, mental health disorders; ref., referent; SUD, substance use disorders; WHO, World Health Organization.

urban centres, rural residents had increased risk of SUD only (aRRR = 1.92) and concurrent disorders (aRRR = 2.35) versus no disorder and were more likely to report concurrent disorders versus MHD only (aRRR = 2.09). Residents of small population centres also had elevated risk of MHD only and concurrent disorders relative to no disorder (aRRRs = 1.60 and 2.43, respectively), and were more likely to report concurrent disorders relative to both MHD only (aRRR = 1.52) and SUD only (aRRR = 1.96). Residents of medium-sized centres were significantly more likely to have concurrent disorders compared to those with SUD only (aRRR = 1.60), despite overall reduced risk for SUD.

A clear gradient was observed with social belonging: compared with those reporting very strong belonging, individuals with very weak belonging had substantially higher risk of concurrent disorders versus no disorder (aRRR = 4.78) and versus MHD only (aRRR = 1.95) or SUD only (aRRR = 3.20). Higher disability scores were also associated with increased risk of all disorder categories, with particularly elevated risk for concurrent disorders (aRRR = 1.06). Disability remained positively associated with concurrent disorders relative to both MHD only (aRRR = 1.01) and SUD only (aRRR = 1.04). Perceived need for mental health care was strongly associated with disorder status: relative to no perceived need, respondents with all needs met, partially met, or unmet needs had higher risk of concurrent disorders (aRRR = 4.25, 6.07, and 5.26, respectively). In comparisons between diagnostic groups, partially met needs were associated with a lower risk of concurrent versus MHD only (aRRR = 0.66), whereas unmet needs were associated with a higher risk of concurrent versus SUD only (aRRR = 4.32).

Pandemic-related stressors were significantly associated with all outcomes. Financial difficulties due to COVID-19 were linked to higher risk of MHD only, SUD only, and concurrent disorders versus no disorder (aRRR = 1.18, 1.39, and 1.63, respectively), and to higher risk of concurrent disorders versus MHD only (aRRR = 1.38). Respondents reporting access barriers to mental health care services had lower risk of MHD only and SUD only versus no disorder (aRRR = 0.81 and 0.53) but higher risk of concurrent disorders versus no disorder (aRRR = 1.48) and versus MHD only and SUD only (aRRR = 1.81 and 2.77). Loneliness was associated with

higher risk of all disorder categories versus no disorder, with the strongest association for concurrent disorders (aRRR = 2.89), although differences between concurrent and single-disorder groups were not statistically significant.

Discussion

This study provides one of the first population-based examinations of concurrent disorders among Canadian adults during the COVID-19 pandemic, using data from MHACS, which covers the 10 provinces. We found that approximately 1.6% of adults experienced concurrent disorders, 12.2% had MHD only, and 1.6% had SUD only. To contextualize these findings, we compared them with the most recent pre-pandemic national data from the 2012 Canadian Community Health Survey-Mental Health (CCHS-MH),[6] which remains the latest population-based pre-pandemic survey using WHO-CIDI diagnostic measures. The prevalence of concurrent disorders rose modestly from 1.2% to 1.6%, MHD only nearly doubled (6.1% to 12.2%), while SUD only declined (3.8% to 1.6%).

Taken together, these patterns suggest a shift toward a higher burden of MHD and a smaller proportion of individuals with isolated SUD. This change likely reflects the cumulative influence of multiple factors over the past decade (e.g. greater awareness, evolving diagnostic and help-seeking practices, and broader societal stressors), with the COVID-19 pandemic as an important, but not sole contributor. Comparisons between 2012 and 2022 should also be made cautiously: the MHACS (2022) used telephone interviews, whereas CCHS-MH (2012) relied primarily on in-person interviews, and other methodological differences may affect estimated prevalence. As a result, the MHACS is best viewed as a post-2020 snapshot that can be compared with 2012 estimates but not used to determine why prevalence changed over time.

Our results highlight that younger age was strongly associated with all disorder categories. Young adults had the highest risks of concurrent disorders; for example, those aged 20 to 24 had over 30 times the risk compared with adults aged 65 and older. This pattern likely reflects both the higher prevalence of MHD and SUD individually in late adolescence and early adulthood, and the social and economic transitions of this period (e.g. schooling, employment, relationships) that can increase vulnerability to both.[12,40] However, given the cross-sectional design, we cannot determine whether early adulthood represents a distinct etiologic "high-risk window" for comorbidity or primarily reflects age-related patterns in mental health and substance use that tend to attenuate across the life course.

Gender patterns showed expected trends: men had lower risk of MHD only (aRRR = 0.64), higher risk of SUD only (aRRR = 3.40), and higher risk of concurrent disorders compared to MHD only (aRRR = 1.59). However, men were far less likely to have concurrent disorders compared to SUD only (aRRR = 0.30), suggesting substance use among men may more often occur in isolation rather than in conjunction with mental health issues.[6,14,26]

2SLGBTQI+ individuals had a 67% higher risk of concurrent disorders versus no disorder compared to non-2SLGBTQI+ respondents and were more likely to experience comorbidity than either disorder alone, consistent with literature documenting heightened pandemic-related disparities in sexual and gender minorities.[32,33,41] These differences likely stem from stigma, discrimination, and barriers to accessing affirming care, underscoring the need for inclusive and culturally competent mental health and addiction service.[32,33,41]

Marital status was significantly associated with disorder categories: individuals who had never been married and those who were separated, divorced, or widowed had higher relative risks of SUD and concurrent disorders compared to those who were married or living common-law. This aligns with existing literature suggesting that marriage may be linked to greater emotional support and social integration, which could buffer stress.[42-44] However, our models did not include an interaction between marital status and gender, so these estimates reflect average associations across genders and may not capture potential gender differences.

Educational attainment showed a consistent inverse association with all disorder types, with individuals holding a bachelor's degree or higher exhibiting substantially lower relative risks. This is consistent with research indicating that higher education correlates with enhanced socioeconomic stability, health literacy, and access to protective resources.[45]

Income effects were nuanced, revealing a clear distinction between drivers of severe comorbidity and single SUD. Middle and high incomes were associated with a decreased risk of concurrent disorders, supporting the view that greater economic resources act as a protective buffer against the chronic stress and instability that precipitate the most severe dual diagnoses.[8,20] Conversely, the same income levels were associated with an increased risk of SUD only. This divergence suggests substance use in affluent groups is often driven by social normalization or recreational factors,[46,47] independent of the overwhelming psychological distress associated with concurrent disorders.

Our findings reveal notable geographic disparities in the prevalence of MHD, SUD, and their co-occurrence. Individuals living in rural and small population centres exhibited higher risks of MHD only and especially of SUD only and concurrent disorders compared to those in large urban areas. In contrast, residents of medium-sized centres had elevated MHD risk but significantly lower risks for SUD and concurrent disorders. These patterns may reflect differences in access to healthcare services, social supports, and environmental stressors outside major urban centres,[26,48] underscoring the need for tailored public health strategies that address the unique challenges faced by rural and smaller communities.

Social belonging showed a clear gradient: weaker belonging was associated with substantially higher risks of all disorder categories, with very weak belonging linked to nearly fivefold higher risk of comorbidity. This association may reflect both the social consequences of living with MHD or SUD and the possibility that low perceived belonging increases vulnerability to these conditions. Given the cross-sectional design, we cannot infer directionality, but the gradient suggests that social integration and community connectedness are important considerations for prevention and treatment planning.

The strong association between functional impairment and concurrent disorders is consistent with prior work showing that comorbid problems are linked to greater disability and role disruption than single

disorders alone.[49,50] In our study, higher WHODAS 2.0 scores were associated with an increased relative risk of all disorder categories, with the largest effect observed for concurrent disorders. This pattern may reflect both the added functional burden of managing co-occurring conditions and the possibility that greater disability increases vulnerability to developing comorbid MHD and SUD, for example through reduced employment, social participation, or access to care. Given the cross-sectional design, we cannot disentangle these pathways, but the findings underscore the importance of integrating functional assessment and rehabilitation supports within services for people with concurrent disorders.

Finally, COVID-19-related financial hardship, loneliness, and disrupted access to care were strongly associated with all disorder categories, particularly concurrent disorders.[34-36] Loneliness nearly tripled risk of concurrent disorders, while access barriers increased comorbidity risk by over 80% compared to MHD only and nearly 180% compared to SUD only. These relationships are likely bidirectional: people with MHD and SUD may be more vulnerable to job loss, isolation, and difficulties navigating care, while these stressors may also worsen or precipitate disorders. Because MHACS is cross-sectional, we cannot determine temporal ordering, but the strong associations highlight the need to address both psychosocial and structural factors in post-pandemic planning.

Strengths and limitations

This study offers several important contributions. First, its 2022 MHACS data from a population-based sample of Canadians aged 15 and older in the 10 provinces, allowing examination of how pandemic-related stressors (e.g. social isolation, financial hardship, care disruptions) relate to MHD and SUD, and their co-occurrence. Second, multinomial regression enables simultaneous comparison of MHD only, SUD only, and concurrent disorders, providing a more nuanced view than binary models. Third, incorporating diverse social determinants and pandemic-related indicators supports a comprehensive understanding of multiple vulnerabilities to inform public health responses.

Limitations include reliance on self-reported, structured diagnostic interviews rather than clinical assessments, which may result in misclassification. Furthermore, the low survey response rate (25%) introduces a risk of non-response bias, meaning the findings may not accurately represent characteristics of the full target population. The cross-sectional design limits causal inference, and findings may not generalize to non-pandemic settings. Survival bias is also possible, particularly among older respondents, if those with earlier-onset MHD or SUD were more likely to die before the survey. Finally, exclusion of residents in the territories and Indigenous communities living on reserves limits generalizability to these populations.

Conclusion

This study provides population-based estimates of MHD, SUD, and concurrent disorders among Canadian adults during the COVID-19 pandemic and identifies key sociodemographic, psychosocial, and pandemic-related characteristics associated with these outcomes. Concurrent disorders affected 1.6% of adults and were most prevalent among younger, 2SLGBTQI+, lower socioeconomic, and rural individuals. High-risk factors consistently included COVID-19 stressors: loneliness, financial hardship, and self-reported difficulty accessing needed care. Given the cross-sectional design, we cannot infer causality; however, the strong association highlights a vulnerable population facing substantial barriers to care. These findings suggest that high-risk groups (e.g. younger adults, people experiencing social isolation) may particularly benefit from targeted interventions and from efforts to improve the accessibility and coordination of mental health and substance use services in the postpandemic context.

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Conflicts of interest

The authors declare that there is no conflict of interest.

Authors' contributions and statement

CF: conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; resources; software; writing—original draft; and writing—review and editing.

MA: conceptualization; investigation; methodology; writing—original draft; and writing—review and editing.

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Original quantitative research

Chronic disease and social isolation among Canadians: evidence from the 2022 Mental Health and Access to Care Survey

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This article has been peer reviewed.

Abstract

Introduction: Chronic conditions are highly prevalent in Canada and are commonly examined as a single, aggregated exposure in population research on social isolation. Such approaches emphasize overall disease burden but make it difficult to distinguish the independent contributions of diagnostic category, chronic pain and disability. In this study, we examine these dimensions separately to assess how each is associated with social isolation among Canadian adults.

Methods: Using the 2022 Mental Health and Access to Care Survey (n = 9861), the association between chronic conditions, chronic pain, and disability in relation to social support was assessed, using the Social Provisions Scale (SPS-10), applying multivariable linear regression.

Results: More severe disability was negatively associated with social support (B = −0.09, 95% CI = −0.11, −0.08). Those with more functional impairments experienced lower social support which typically indicates greater social isolation.

Conclusion: When examined jointly, functional disability, but not chronic disease category or chronic pain, was independently associated with lower social support. These findings indicate that social isolation among Canadian adults is more closely related to functional limitation than to diagnostic labels, underscoring the importance of function-focused approaches in research and intervention.

Keywords: *chronic disease, chronic pain, people with disabilities, social isolation, health policy*

Highlights

- This study examines the simultaneous impact of chronic conditions, chronic pain, and disability on social isolation using nationally representative Canadian data.
- Diagnostic labels alone are not associated with social isolation when functional limitation and pain are accounted for.
- The functional limitation is a key predictor of reduced social support, increasing social isolation.
- It is important to analyze chronic disease, chronic pain and disability together in population-level research on social isolation.

Introduction

Chronic disease is highly prevalent among Canadian adults, carrying profound social implications like social isolation—a state of having limited social contacts or interactions.[1,2] Social isolation is a significant public health issue, particularly in aging societies.[2,3] In Canada, about 16% of seniors experience social isolation, with about 30% at risk due to deteriorating health.[3] Nearly half of Canadians lived with at least one major chronic condition in 2021, and 1 in 12 had three or more; a substantial portion of the population occupies the social/health contexts in which social isolation is likely to be reported.[4] Research on social isolation and health spans the adult life course, often emphasizing later life stages where social isolation is more prevalent, with well-documented associations between isolation, chronic conditions, and adverse health outcomes.[5-8] Chronic conditions may not operate uniformly in relation to social isolation, highlighting the importance of examining heterogeneity across conditions when considering population-level intervention strategies.

Adults living with chronic illness are more likely to experience social isolation.[9,10] One scoping review on the topic found that multimorbidity (e.g. having multiple overlapping chronic conditions) is linked to greater loneliness, with less evidence

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connecting social isolation.[10] A later review replicated this finding among older adults.[11] One assessment of the Canadian Longitudinal Study on Aging (n = 29 847) found that multimorbidity was linked to higher social isolation, though effects were modest.[9] The same study shows that chronic illness modifies the impact of social roles (e.g. family, work, community engagements), on isolation with the presence of chronic disease mitigating access to these roles and their beneficial effects.[9] Galvanizing these findings, policy reports list poor health and multiple chronic diseases as contributors to social isolation in later life.[3,12] These works highlight the need for more population-level examinations of chronic disease and social isolation, particularly in Canada.

Research has explored chronic conditions as a homogenized category capturing the combined influence of *any* condition, despite evidence suggesting that social isolation varies substantially across conditions.[13] Grouping diverse conditions risks obscuring important mechanisms and points of intervention. For example, heart disease and related conditions have well-documented links with social isolation that warrant further exploration.[14] Social isolation is associated with worse cardiovascular prognoses. One meta-analysis showed that patients with poor social relationships characterized by social isolation and loneliness faced a 29% increased risk of coronary heart disease (CHD) and 32% increased risk of stroke.[15] One cross-sectional study of 2521 Danish cardiac patients showed that loneliness and social isolation frequently co-occurred with low health literacy and high treatment burden, suggesting isolation may result from, and contribute to, difficulties in managing cardiovascular health.[16] Similar findings exist for other conditions. Osteo- and rheumatoid arthritis are associated with increased risk of social isolation.[17,18] One longitudinal European study found that more severe osteoarthritis was associated with a 47% increased risk of becoming socially isolated, even after adjusting for sociodemographic factors as well as depression and mobility.[19]

Chronic pain and functional disability may link chronic conditions to social isolation. Pain can be a direct symptom (e.g. arthritis) or the result of complications of illness (e.g. diabetic neuropathy or cancer). Individuals with chronic pain are vulnerable to social isolation, which may exacerbate a decline in mobility.[20] Pain is often tied to social isolation through multiple chronic conditions with emphasis on musculoskeletal pain.[21-23] To understand how chronic conditions uniquely affect social isolation, disaggregated individual chronic conditions (e.g. CVD, arthritis) should be assessed simultaneously alongside comorbidities like pain and functional disability.

Not all mechanisms of chronic conditions are physical. For example, cancer diagnosis and treatment disrupts daily routines and alters social identity. A 2023 American Cancer Society survey found that over half of cancer survivors felt more socially isolated, citing fatigue, pain, and fear of burdening others.[24] While some reported closer family ties, cancer was generally linked to heightened loneliness and isolation with implications for quality of life and survival.[24] Changed social identity and its interconnectivity with isolation in relation to chronic conditions is not unique to cancer. Chronic mental health conditions also exhibit an association with social isolation, with 53 studies in an umbrella review finding consistent associations between loneliness, isolation, and diagnoses such as depression and psychosis, though the individual review quality was low.[25,26] Stigma compounds this phenomenon, with one qualitative study of young adults with depression describing stigma as a driver of secrecy and increased isolation.[27] Perhaps more so than physical illnesses, mental illnesses can erode both the ability and motivation to socialize, making them particularly salient for social isolation research.

Social isolation is a major public health concern. Using the 2022 Mental Health and Access to Care Survey (MHACS) (n = 9861), a weighted, nationally representative sample of the Canadian population, we examine how chronic conditions, chronic pain, and disability were associated with the Social Provisions Scale (SPS-10) scores, a measure of perceived social support.[28,29] Social support is a closely related dimension of social relationships that often covaries with social isolation.[5,30] The SPS-10 measures social support at both the structural and functional levels, indicating the presence of relationship ties, characteristics of interactions (e.g. frequency), appraisals of support, level of social network integration, and purpose of relationships.[31,32] Higher SPS-10 scores indicate greater perceived social support, which is typically associated with lower social isolation.[5,30] Thus, while we report results in terms of social support, we discuss implications for social isolation as an associated public health issue. In our analysis, we investigated a disaggregated measure of chronic disease, looking at individual and overlapping chronic conditions in association with social isolation, alongside chronic pain, disability, and sociodemographic controls. We extended population-level research on social isolation with evidence from the Canadian population, and expanded assessments of chronic disease by considering physical and mental conditions simultaneously.

Methods

Data source

This study used the MHACS, a weighted, nationally representative, cross-sectional survey collected by Statistics Canada between 17 March and 13 July 2022.[28] The MHACS had a response rate of 25%, with 9861 individuals out of 39 485 responding.[28] The MHACS collected data on health status and health service access before/during the COVID-19 pandemic, with numerous variables related to subjective well-being, mental disorder, chronic disease/pain, and disability, alongside a robust list of sociodemographics. Respondents were aged 15 and older from all provinces and territories, excluding: Indigenous peoples on reserve, people in some rural areas, Canadian Armed Forces members, and institutionalized individuals. Data collection was stratified to oversample for Canada's four largest visible minority groups (Black, South Asian, Chinese, Filipino), and to adequately represent various age (15–24, 25–44, 45–64, 65 +) and gender (men, women) demographics. More details on variables and sampling design are available through the MHACS user guide, questionnaire, and data dictionary.[28]

Variable definitions

Our outcome is the SPS-10, a validated measure ranging from 10 to 40 points of perceived social support that sums respondents' level of agreement, on a scale of 1 (strongly disagree) to 4 (strongly agree), with 10 questions pertaining to five different factors: attachment, guidance, social-integration, reliable alliance, and reassurance of worth.[29] The SPS-10 measures social support at both the structural and functional

levels, indicating the presence of relationship ties, characteristics of interactions, appraisals of support, level of social network integration, and purpose of relationships.[31,32] Higher SPS-10 scores indicate greater perceived social support, which we discuss in relation to social isolation given that it is a common covariate.[5,30]

We identified three distinct predictors of interest: (1) disability; (2) chronic pain; and (3) chronic conditions. To consider each exposure's association with social isolation net of other factors, all three were assessed in one analytic model alongside sociodemographic controls.

Disability was operationalized through the 12-item World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0), a validated measure ranging from 0 to 40 points that sums respondents' level of difficulty, on a scale of 1 (none) to 5 (extreme/cannot do), achieving cognitive, mobility, self-care, interpersonal, and daily life activities, where higher scores indicate greater levels of disability.[33] The WHODAS 2.0 does not reference pain in any questions pertaining to disability, making it distinct from the measure of pain analyzed.

Chronic pain was measured using the Health Utilities Index (HUI) pain-by-interruption-of-activities metric.[34] Specifically, the HUI Mark 3 (HUI3) classification system was used to construct the variable using two questions: (1) a question asking whether the respondent was "usually free of pain or discomfort"; and (2) a question asking the number of activities that a respondent's pain or discomfort prevented.[28,34] The variable consists of five categories: no pain or discomfort, pain—does not prevent activity, prevents few activities, prevents some activities, and prevents most activities.

Chronic conditions consisted of 10 categories: no identified condition, cardiovascular (high blood pressure, heart disease), asthma, diabetes, arthritis, back problems (excluding fibromyalgia/arthritis), migraine headaches, mental disorders (depression, dysthymia, mania, bipolar, generalized/social anxiety, obsessive-compulsive, panic, posttraumatic stress disorder [PTSD], attention-deficit disorder [ADD]), other unspecified conditions (chronic bronchitis/emphysema/chronic obstructive pulmonary disease, cancer, bowel disorder/Crohn's/ulcerative colitis, chronic fatigue syndrome, multiple chemical sensitivities, learning disabilities, schizophrenia, psychosis, eating disorders, and other unidentified long-term physical or mental health conditions), and multiple overlapping conditions. This variable was constructed from respondents' answers to binary (no/yes) questions that asked if they had any of the listed conditions. Categorizations first followed the Canadian Chronic Disease Surveillance System (CCDSS).[35] Conditions in MHACS that were identical to chronic disease categorizations made by the CCDSS (e.g., arthritis) were left as single-condition categories when they had a large enough sample size to adhere to survey release rules. Conditions that did not match any CCDSS definition were either left as single-condition categories (e.g. migraine headaches) or merged with other conditions when sample size was too small to adhere to the MHACS pre-weighted sample-size release rules.[28] Single categories are mutually exclusive. The "other unspecified condition" category merged any conditions with too few respondents to be analyzed alone.[28,*] The "multiple overlapping conditions" category includes respondents with more than one condition.

Sociodemographic controls included age, gender, visible minority status, 2SLGBTQI+ status, education, employment status, household income, marital status, immigrant status, region of residence, and religiosity.[28,34] Age was recoded to match the target strata of MHACS: 15 to 24, 25 to 44, 45 to 64, and 65 and older. Gender included Men+ and Women+. The plus sign indicates that non-binary respondents have been randomly distributed into each category.[†] Visible minority status consisted of not a visible minority (White, Indigenous) and visible minority (Black, South Asian, Chinese, Filipino, other).[‡] 2SLGBTQI+ status included Non-2SLGBTQI+ person and 2SLGBTQI+ person categories.[§] Education was recoded to merge small categories: less than high school, high school or equivalent, college, trades, or apprenticeship, university below bachelor's degree, and bachelor's degree or higher categories. Employment status was constructed from a three-category variable that asked respondents their working status.[**] Worked and absent from work were merged into employed, while "did not have a job" was coded as unemployed. A third category, "excluded," was added to prevent loss of all respondents above age 75 upon casewise deletion.[††]

Household income in Canadian dollars (CAD) was recoded from 15 categories to: less than $20 000, $20 000 to $39 999, $40 000 to $59 999, $60 000 to $79 999, and $80 000 or more following previous work with MHACS.[36] Marital status was recoded to merge small categories: married or common law, never married, and widowed, separated, or divorced.[28,37] Immigrant status included: non-immigrants and

* Schizophrenia, psychosis, and eating disorders were categorized under other, rather than with mental disorders, due to pregrouping by Statistics Canada in the MHACS public use microdata that made recoding these individual conditions impossible.

† The decision to impute non-binary respondents into each gender category was made by Statistics Canada. The format of the public use microdata file prevented the authors from undoing this change.

‡ The decision to categorize Indigenous peoples as not a visible minority was made by Statistics Canada. The format of the public use microdata file prevented the authors from undoing this change.

§ This variable categorizes anyone "who is not cisgender and/or whose sexual orientation is not heterosexual under the umbrella term 2SLGBTQI+." It therefore represents a mix of both sexual orientation and gender identity. This categorization was chosen by Statistics Canada. The format of the public use microdata file prevented the authors from undoing this change

** Statistics Canada, the MHACS public use microdata file, nor the codebooks or user guide associated with the MHACS provide any information on how students were categorized in this data.

†† Statistics Canada and the creators of the MHACS survey did not ask any employment-related questions to respondents aged 75 and older. When combined with casewise deletion, this leads to the loss of 2504 respondents in the 65 and older age category, cutting the proportion of the sample from about 20% to about 2%. According to the codebooks associated with the MHACS survey, there are 2504 valid skips aged 65 and older in the employment variable (respondents aged 75 and older not asked the question). In the public use microdata file, there are 2507 respondents in the 65 and older age category who are lumped together as missing or NA. This means that three respondents were asked the question but did not answer. In terms of missingness, there are 2504 structurally missing and three non-structurally missing. Due to the way the public use microdata file is constructed, there was no way to identify and separate the three from the 2504. We therefore decided that it is more analytically sound to risk improperly categorizing three respondents, as opposed to removing 2504 from the analysis. As such, the 2507 respondents in the 65 and older category that were missing for employment status were recoded as an "Excluded" category in the employment status variable. Given that employment status is only a control variable with no hypothesized interpretation, we believe this to be an appropriate fix.

immigrants. Region of residence consisted of rural (< 1000 people), small pop. centre (1000–29 999), medium population centre (30 000–99 999), and large urban population centre (> 100 000). Finally, religiosity measured how important religion or spirituality was to a respondent: not at all important, not very important, somewhat important, and very important.

Statistical analysis

Following prior MHACS research, missing data for any variables were removed using casewise deletion.[36,37] This study has 7994 eligible respondents. Accounting for the complex survey design of the MHACS, survey and bootstrap weights were applied as directed by Statistics Canada.[28] Weighted bivariable and multivariable linear regression models were run in R version 4.5.2 (R Foundation for Statistical Computing, Vienna, AT), with the latter assessing how all three exposures alongside controls were associated with social isolation simultaneously.

Results

Table 1 presents the weighted sample characteristics, including the mean and category percentages with corresponding 95% confidence intervals [CI]. The mean average score for the outcome variable social isolation was 35.4 (35.3, 35.6).

The analysis of these sociodemographics showed that most participants were age 25 to 44 (33.9% [33.4%, 34.5%]); identified as Women + (50.6% [50.6%, 51.2%]); not a visible minority (74.1% [73.3%, 74.9%]); not 2SLGBTQI + (93.8% [93.1%, 94.4%]), had a bachelor's degree or higher (31.9% [30.8%, 33.0%]), employed (61.1% [60.0%, 62.2%]), with a household income of ≥ CAD 80 000 (67.0% [65.7%, 68.2%]), married or living common law (58.1% [56.9%, 59.4%]), non-immigrants (70.8% [69.7%, 71.9%]), in large urban population centres (61.6% [60.3%, 62.8%]), and perceived religion as not at all important (28.1% [26.8%, 29.3%]).

Our exposures were oriented as follows: mean average disability score of 6.3 (6.0, 6.6), most participants experienced no pain or discomfort (77.2% [76.1%, 78.3%]), and had no identified chronic condition (36.5% [35.2%, 37.8%]).

TABLE 1
Sample characteristics

Characteristic	Full sample (n = 7994) Weighted percent (95% CI)
Age	
15–24	14.4% (14.1%, 14.8%)
25–44	33.9% (33.4%, 34.5%)
45–64	31.7% (31.1%, 32.2%)
65 or older	19.9% (19.5%, 20.4%)
Gender	
Men+	49.4% (48.8%, 50.0%)
Women+	50.6% (50.0%, 51.2%)
Visible minority status	
Not a visible minority	74.1% (73.3%, 74.9%)
Visible minority	25.9% (25.1%, 26.7%)
2SLGBTQI+ status	
Non-2SLGBTQI+ person	93.8% (93.1%, 94.4%)
2SLGBTQI+ person	6.2% (5.6%, 6.9%)
Education	
Less than high school	9.9% (9.1%, 10.7%)
High school or equivalent	24.0% (22.9%, 25.2%)
College, trades, or apprenticeship	29.7% (28.4%, 30.9%)
University below bachelor's degree	4.5% (4.0%, 5.1%)
Bachelor's degree or higher	31.9% (30.8%, 33.0%)
Employment status	
Unemployed	20.6% (19.5%, 21.6%)
Employed	61.1% (60.0%, 62.2%)
Excluded	18.3% (17.8%, 18.8%)
Household income	
< CAD 20 000	2.6% (2.1%, 3.0%)
CAD 20 000–39 999	7.3% (6.6%, 8.0%)
CAD 40 000–59 999	11.1% (10.2%, 12.0%)
CAD 60 000–79 999	12.1% (11.2%, 12.9%)
≥ CAD 80 000	67.0% (65.7%, 68.2%)
Marital status	
Married or common law	58.1% (56.9%, 59.4%)
Never married	29.5% (28.5%, 30.6%)
Widowed, separated, or divorced	12.3% (11.4%, 13.2%)
Immigrant status	
Non-immigrant	70.8% (69.7%, 71.9%)
Immigrant	29.2% (28.1%, 30.3%)
Region of residence	
Rural (< 1000 people)	18.6% (17.5%, 19.7%)
Small population centre (1000–29 999 people)	11.2% (10.4%, 12.0%)
Medium population centre (30 000–99 999 people)	8.6% (7.8%, 9.4%)
Large urban population centre (> 100 000 people)	61.6% (60.3%, 62.8%)

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TABLE 1 (continued)
Sample characteristics

Characteristic	Full sample (n = 7994) Weighted percent (95% CI)
Religiosity	
Not at all important	28.1% (26.8%, 29.3%)
Not very important	20.6% (19.6%, 21.7%)
Somewhat important	24.1% (22.9%, 25.2%)
Very important	27.2% (26.1%, 28.3%)
Chronic conditions	
None identified	36.5% (35.2%, 37.8%)
Cardiovascular	5.8% (5.2%, 6.4%)
Asthma	2.6% (2.2%, 3.0%)
Diabetes	1.6% (1.3%, 1.9%)
Arthritis	3.6% (3.1%, 4.1%)
Back problems (Excluding fibromyalgia/arthritis)	4.6% (4.0%, 5.2%)
Migraine headaches	3.6% (3.1%, 4.1%)
Mental disorder	7.1% (6.4%, 7.8%)
Other unspecified	6.2% (5.5%, 6.8%)
Multiple overlapping	28.5% (27.3%, 29.7%)
Pain level	
No pain or discomfort	77.2% (76.1%, 78.3%)
Pain – does not prevent activity	7.1% (6.4%, 7.8%)
Pain – prevents few activities	7.4% (6.7%, 8.1%)
Pain – prevents some activities	5.0% (4.4%, 5.6%)
Pain – prevents most activities	3.3% (2.8%, 3.8%)
WHO Disability Assessment Schedule (0-40) [Mean]	6.3 (6.0, 6.6)
Social Provisions Scale (10–40) [Mean]	35.4 (35.2, 35.5)

Abbreviations: 2SLGBTQI+, Two-Spirit, lesbian, gay, bisexual, transgender, queer, intersex, and additional people who identify as part of sexual and gender diverse communities; CI, confidence interval; WHO, World Health Organization.

Notes: Percentages may not add up to 100 due to rounding errors.

The plus (+) sign in each gender category indicates that non-binary respondents have been randomly distributed into each category. Decision made by Statistics Canada and the creators of the MHACS.

The 2SLGBTQI+ variable categorizes anyone "who is not cisgender and/or whose sexual orientation is not heterosexual under the umbrella term 2SLGBTQI+." It therefore represents a mix of both sexual orientation and gender identity. Decision made by Statistics Canada and the creators of the MHACS.

Statistics Canada, the MHACS public use microdata file, nor the codebooks or user guide associated with the MHACS provide any information on how students were categorized in these data.

Results of weighted bivariable (unadjusted) and multivariable (adjusted) linear regression models are in Table 2. Accounting for exposures and sociodemographic controls, only disability was significantly associated with the SPS-10 in the multivariable model (B = −0.09 [95% CI = −0.11, −0.08]). No chronic disease category or pain level was significantly associated with the SPS-10 in the multivariable model.

Discussion

We assessed the association between chronic conditions, chronic pain, and disability, and the SPS-10 scores. While the SPS-10 is a measure of social support, it covaries with social isolation, which is our focus. The results demonstrated that only disability was significantly associated with the SPS-10 scores in the Canadian population at the time of data collection. While our practical effect size is modest; 12% decrease in SPS-10 score across the range of the WHODAS 2.0, the association is meaningful in a population context, given the high prevalence of functional limitations among Canadian adults.[1,3,‡‡] These results underscore the importance of focusing on functional capacity rather than diagnostic labels when assessing social vulnerability. Our model highlights the importance of considering different aspects of the illness experience together to understand how the intersection of disease, pain, and disability functions in association with social isolation.

No chronic disease category nor chronic pain level was independently associated with the SPS-10 scores after accounting for other exposures and sociodemographic factors. Rather than indicating an absence of risk, these null findings suggest that the relationship between chronic health and isolation is not driven by diagnosis alone. One possible explanation is that much of the existing research examines conditions in isolation, focusing on clinical or disease-specific outcomes.[38,39] Studies that analyze chronic conditions on their own without disability and chronic pain risk obscuring how each condition is associated with isolation. Under these circumstances, omitted variable bias affects coefficient strength, potentially making some conditions appear more strongly tied to the outcome under study. By assessing disaggregated conditions alongside pain, disability, and sociodemographic controls with nationally representative data, we show that the association of many conditions diminishes. Thus, the risk of isolation associated with specific chronic conditions may be less about the diagnosis itself, with disabling consequences and social position being more relevant. Future research should explore these pathways in greater detail.

The absence of an independent association between chronic pain and the SPS-10 scores further suggests that pain may operate on social isolation indirectly through functional limitation rather than serving as a standalone predictor. Pain can restrict mobility, reduce endurance, and limit engagement in social activities, but its

‡‡ Practical effect size in terms of percent change is calculated by taking the full-scale change of the coefficient for WHODAS 2.0 and dividing it by the range of the SPS-10.

Specifically: $\frac{(-0.09 * 40)}{30} \times 100 = 12\%$

This indicates the difference in the outcome between someone with no disability and someone with the highest score of disability. In order to see the percent change in the SPS-10 caused by a one-point increase in the WHODAS 2.0 scale, the reader should divide the total change (12%) by the range of the WHODAS 2.0 scale (40).

TABLE 2
Bivariable/multivariable linear regression predicting social isolation (n = 7994)

Characteristic	Bivariable (95% CI)	Multivariable (95% CI)
Chronic conditions		
None identified	Referent	Referent
Cardiovascular	0.11 (−0.35, 0.57)	0.29 (−0.17, 0.75)
Asthma	0.64 (−0.09, 1.38)	0.19 (−0.49, 0.87)
Diabetes	−0.63 (−1.50, 0.25)	−0.32 (−1.17, 0.54)
Arthritis	−0.12 (−0.71, 0.47)	−0.23 (−0.87, 0.42)
Back problems (excluding fibromyalgia/arthritis)	−0.01 (−0.63, 0.61)	0.08 (−0.52, 0.68)
Migraine headaches	0.05 (−0.57, 0.67)	−0.21 (−0.80, 0.38)
Mental disorder	−0.30 (−0.81, 0.21)	−0.21 (−0.72, 0.30)
Other unspecified	0.27 (−0.22, 0.77)	0.17 (−0.29, 0.63)
Multiple overlapping	−0.80 (−1.11, −0.48)***	−0.19 (−0.53, 0.15)
Pain level		
No pain or discomfort	Referent	Referent
Pain – does not prevent activity	−0.19 (−0.65, 0.27)	−0.10 (−0.55, 0.35)
Pain – prevents few activities	−0.76 (−1.24, −0.29)**	−0.33 (−0.81, 0.15)
Pain – prevents some activities	−0.83 (−1.48, −0.17)*	0.12 (−0.50, 0.74)
Pain – prevents most activities	−2.13 (−3.06, −1.20)***	0.22 (−0.72, 1.17)
WHO Disability Assessment Schedule (0–40)	−0.01 (−0.11, −0.08)***	−0.09 (−0.11, −0.08)***

Abbreviations: CI, confidence interval; WHO, World Health Organization.

Note: Multivariable model controls: age, gender, visible minority status, 2SLGBTQI+ status, education, employment status, household income, marital status, immigrant status, region of residence, and religiosity.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

social consequences may be most pronounced when it translates into measurable disability. This interpretation aligns with conceptual models that distinguish symptoms from their downstream functional and social effects and highlights the importance of examining mediating pathways in future research. Taken together, these findings reinforce the need to shift theoretical and empirical attention away from disease-specific explanations of social isolation and toward functional mechanisms that cut across diagnostic boundaries. Specifically, future research with more robust data (e.g. longitudinal studies with greater sample size) should explore these mediation pathways.

Disability was significantly associated with social isolation in our multivariable model. This follows trends identified in the literature that emphasize the importance of functional impairment as a driver of social isolation across conditions.[20,40] Functional limitations can restrict participation in social activities, create logistical barriers to interaction, and contribute to feelings of burden, all of which heighten isolation. Our results suggest that once disability and other sociodemographic factors are considered, other exposures such as chronic pain may operate indirectly through disability, rather than serving as a standalone predictor of isolation. Policy initiatives aimed at improving mobility, reducing barriers to participation, and expanding assistive technologies are likely to be more effective at reducing isolation than interventions focused solely on managing chronic conditions. From a health system perspective, integrating disability assessments into routine chronic disease care could help identify individuals most at risk of isolation and enable proactive social prescribing or community referrals. Further disaggregation of disability with other measures would yield even more nuanced perspectives as the WHODAS 2.0 does not have a universally agreed upon cutoff indicating disability.[41]

Strengths and limitations

Our measure of chronic conditions disaggregated conditions individually where possible, while also including both physical and mental conditions, rather than homogenizing dissimilar conditions. This provided a glimpse at (non-significant) associations obscured in previous homogenized analyses. Our results affirm the importance of disability as a central determinant of isolation, which suggests that interventions should prioritize functional supports and accessibility improvements.

Cross-sectional data prevents causal inference; however, the MHACS provides a robust nationally representative picture of the relationship between chronic conditions, chronic pain, disability and social isolation at the time of collection.

More could be done to tease out potential associations between individual chronic disease categories that were not separable in the present study (e.g. cancer).

Casewise deletion and the MHACS preweighted sample size release rules limit meaningful subgroup analysis. Future research should hypothesize mediating/moderating pathways in relation to sociodemographics like age, gender, socioeconomic status, and race/ethnicity using more empirically robust data (e.g. longitudinal) and a more direct measure of social isolation.

This survey was conducted late in the COVID-19 pandemic, when patterns of social participation were altered. This may limit generalizability to postpandemic contexts, being informative for understanding how functional constraints shape social isolation under conditions of restricted social engagement.

Conclusion

This study examined how chronic conditions, chronic pain, and disability were associated with the SPS-10 scores, framed in relation to social isolation among Canadian adults. After adjustment for sociodemographic factors, disability was the only exposure associated with social isolation. This suggests that social isolation is more closely linked to functional limitation than to diagnostic labels or symptoms alone. Analyzing chronic disease, pain, and disability within a single population-level model, this study clarifies that disability and functional limitations restricting social participation/engagement may matter more for social isolation. This

distinction has implications for health policy and intervention, underscoring the value of functional assessments in identifying individuals at risk of social isolation. Efforts to reduce social isolation may be most effective when they focus on reducing functional barriers and supporting participation, rather than targeting chronic conditions in isolation.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Authors' contributions and statement

DD: conceptualization; funding acquisition; formal analysis; methodology; visualization; writing—original draft, review and editing.

FR: conceptualization; funding acquisition; formal analysis; methodology; visualization; writing—original draft, review and editing.

NDS: conceptualization; methodology; supervision; writing—review and editing.

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In Memoriam – Honouring Dr. Don Wigle

We would like to acknowledge the passing of Don Wigle, MD, PhD, MPH, who died on February 19, 2026, in Ottawa. In 1980, Don was the impetus for the creation of a new journal, *Chronic Diseases in Canada*. The journal was renamed *Chronic Diseases and Injuries in Canada* in 2011 and *Health Promotion and Chronic Disease Prevention in Canada* in 2015. Don saw the establishment of the journal as a key mechanism to highlight the research and surveillance activities of the Laboratory Centre for Disease Control (a precursor of the Public Health Agency of Canada) and of other Canadian health researchers. Don was the principal investigator of many epidemiological studies of environmental hazards, including studies of radon and pesticides, and was a fearless champion for government action against cigarette smoking.

Other PHAC publications

Researchers from the Public Health Agency of Canada also contribute to work published in other journals and books. Look for the following articles published in 2026:

Amaratunga K. What remains. JAMA. 2026;335(7):578-9. https://doi.org/10.1001/jama.2025.23936

Andreacchi AT, Carnide N, Fuller A, **Blair A**, Siddiqi A, Shahidi FV. Socioeconomic inequities in drug poisoning deaths in Canada. Can J Public Health. 2026. https://doi.org/10.17269/s41997-026-01166-1

Biswas A, Chen C, **Lang JJ**, Villeneuve PJ, Smith PM, **Prince SA**. The interplay of home and work neighbourhood environment characteristics and associations with active commuting. J Transp Health. 2026;48:102278. https://doi.org/10.1016/j.jth.2026.102278

Marín-Jiménez N, Bizzozero-Peroni B, Molina-Garcia P, Ortega FB, Chaput JP, Zhang K, **Lang JJ**, et al. Clinical importance of simple muscular fitness tests to predict long-term health conditions: a systematic review and meta-analysis of 94 cohort studies. Br J Sports Med. 2026:bjsports-2024-109173. https://doi.org/10.1136/bjsports-2024-109173