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Socio-economic factors associated with alcohol and cannabis use across waves of the COVID-19 pandemic: an intersectional analysis of a repeated cross-sectional survey

Nibene H. Somé^{1,2,3,4*}, Sameer Imtiaz⁵, Samantha Wells^{3,5,6,7,8}, Claire de Oliveira^{2,4,5,6}, Hayley A. Hamilton^{5,6}, Shehzad Ali^{3,9,10,11,12}, Tara Elton-Marshall¹³, Jürgen Rehm^{5,6,14,15} and Kevin Shield^{5,6,14}

Abstract

Background This study examined trends in cannabis and alcohol use among Canadian adults and across socio-economic subgroups over four waves of the COVID-19 pandemic from 2020 to 2022. Interactions between socio-economic status (SES) and gender, ethnoracial background, and age as they are associated with alcohol and cannabis use were examined.

Methods Data were collected from nine consecutive web-based cross-sectional surveys of adults living in Canada (8,943 participants) conducted from May 2020 to January 2022. Substance use measurements included self-reported changes in alcohol and cannabis use compared to before the pandemic, heavy episodic drinking (HED) (i.e., consumption of 4 or more and 5 or more standard drinks on one drinking occasion for men and women, respectively), and cannabis use in the past 7 days. The Wilcoxon rank-sum test was used to test for equality of the prevalence of substance use. Stepwise logistic regression models were used to assess the associations of SES and its interactions with gender, ethnoracial background, and age with alcohol and cannabis use.

Results The prevalence of increased alcohol and cannabis use differed through the pandemic waves depending on SES. The prevalence of HED and increased cannabis use were similar across SES groups. Having a moderate or high household income and being unemployed were associated with HED and a perceived increase in alcohol use. People in racial and ethnic minority groups with a household income of \$40,000 to \$79,999 had greater odds of engaging in HED than White persons in households with less than \$40,000. Women and individuals aged 40 to 59 years with a high household income (\geq \$120,000) were more likely to report increased alcohol consumption than men and individuals aged 18 to 39 years in households with an income of less than \$40,000. Protective factors associated with HED were being a woman with a university degree and an older adult with a college degree. Protective factors associated with cannabis use or perceived increases in cannabis use included women with a university degree, aged

*Correspondence:
Nibene H. Somé
nsome@uwo.ca

Full list of author information is available at the end of the article



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39 years or more with a university or college degree and being in racial and ethnic minority groups with a university degree.

Conclusions Associations between SES and substance use differ by gender, race and age. To reduce health disparities, public health interventions should account for these interactions.

Keywords Alcohol, Cannabis, COVID-19, Socio-economic status, Intersectionality

Introduction

The COVID-19 pandemic has been a source of substantial psychological stress and concern for many Canadians [1–3] due partly to the social, health, economic, and financial upheavals the pandemic and the resulting social distancing policies have caused. By April 2020, over five million Canadians were negatively impacted by COVID-19-related restrictions in the form of economic or employment hardships, including income loss, job loss and/or reduced work hours [4]. Evidence indicates that periods of financial crisis are associated with higher psychological stress among the population [5], increased alcohol use [6, 7] and cannabis (also known as marijuana, hash, or “pot”) use [7]. Note that alcohol and cannabis are the two most commonly used substances in Canada [8, 9]. Additionally, socio-economic factors, such as income, education level, and employment status, have been associated with the use of alcohol and cannabis as a means of coping [10–14].

Various theoretical approaches exist for understanding the effects of COVID-19, all of which recognize the pandemic as a significant life-changing event. This event can be viewed as a stressful situation, a traumatic experience, a shared trauma, or a source of loss and grief (see Gouzman et al. [15] for a detailed review). These experiences are considered stressors that impact people’s mental health and well-being differently, as they may perceive them in different ways due to differences in their socio-economic status (SES), which in turn might influence their coping mechanisms. Empirical evidence also shows significant disparities in psychological distress and substance use across SES after exposure to stressful life events. For example, people with low SES (including people of low income, living in the most deprived areas, or with a college/high school or less) are more likely to experience higher psychological distress [16, 17] and use more alcohol and cannabis compared to those with high SES (including people of high income, living in the less deprived areas, or with a university degree) [12, 13, 18, 19]. A notable proportion of people increased their use of substances during the pandemic, such as alcohol [20–24] and cannabis [20, 24–26], with some evidence showing that they were using substances to cope with financial distress [9, 27, 28]. Given the associations of alcohol and cannabis use with acute and chronic harm, these coping strategies may have adverse health consequences

[29–34]. Thus, it is important to examine socio-economic factors that may influence the use of alcohol and cannabis during the pandemic.

Studies assessing the relationship between socio-economic factors and substance use patterns during the pandemic vary in terms of the methods used and findings obtained. Most prior studies used a single cross-sectional survey to assess substance use (including alcohol and cannabis) early in the pandemic [11, 20, 35–37]. Additionally, existing literature has found mixed evidence for the associations of SES with alcohol and cannabis use during the pandemic. For example, an association between higher income and increased alcohol use during the pandemic was documented in studies from Canada (annual household income \$80,000 to <\$120,000 or ≥\$120,000 as compared to having an income <\$40,000) [38, 39], Spain (individual monthly income >€1,999 vs. no income) [11], Australia (fortnightly household income ≥\$2000 vs. <\$2,000) [40] and the UK (annual household income ≥ £30,000 vs. < £30,000) [41]. In contrast, a higher income was associated with a lower risk of increased alcohol consumption during the pandemic in veterans in the US (annual household income ≥\$60,000 vs. < \$60,000) [42] and in the general population of Austria (annual household income ≥€50,000 vs. <€25,000) [43].

Although these studies were useful in assessing associations between SES and alcohol and cannabis use, they did not examine the trends in alcohol and cannabis use among socio-economic subgroups across pandemic waves. In addition, they did not include an intersectionality perspective focused on the interactions of SES indicators with gender, race, and age in people’s use of alcohol and cannabis during the pandemic. Researchers are increasingly applying an intersectional lens to understand the combination of socio-economic and individual characteristics, such as gender, race, and age, in terms of how they may be related to mental health [16, 44–47] and alcohol and cannabis use [18, 40, 48–52]. The present study draws on repeated cross-sectional surveys conducted at different time points in Canada to examine changes in alcohol and cannabis use at the intersection of SES with gender, ethnoracial background, and age. Our specific objectives are to (i) analyze trends in alcohol and cannabis use, as well as perceived changes in these substances, across different socio-economic subgroups

over four waves of the pandemic from 2020 to 2022; (ii) evaluate the relationship between SES and both alcohol and cannabis use, along with perceived changes in their usage; and (iii) investigate how alcohol and cannabis use and perceived changes in usage, relate to the intersections of SES with gender, race, and age during the pandemic.

Research indicates that in Canada, women's alcohol consumption has significantly increased regardless of SES [53]. Additionally, racial and ethnic minority groups may be at a higher risk of alcohol-related harm due to patterns of risky and harmful drinking [54]. We hypothesized that people with a low SES (e.g., low income, low educational attainment, or being unemployed), who also self-identify as belonging to under-represented groups, including women and racial and ethnic minority groups, have an increased likelihood of using alcohol and cannabis and self-report an increase in both substance use. In addition, in light of evidence that, irrespective of SES, younger individuals were more likely than older adults to use alcohol and cannabis and to engage in risky use [53, 55–57], we hypothesized that people with a low SES who are younger in age would be more likely than those with a higher SES and in older age groups to use alcohol and cannabis and self-report an increase in both substance use.

Methods

Study design and data collection

The data used in this study were collected from nine consecutive web-based, cross-sectional surveys of adults aged 18 and older residing in Canadian provinces and territories, involving approximately 1,000 participants each. The survey samples were derived from a web panel called Asking Canadians (<http://www.delvinia.com/solutions/askingcanadians>), hosted by Delvinia (a survey firm). Invitations were sent to selected participants using the quota sampling method to approximate the distribution of the English-speaking population in Canada by age, gender, and region [58]. Participants completed an electronic consent form before taking the survey. The study received ethics approval from the Centre for Addiction and Mental Health. Six surveys were conducted in the year 2020 with response rate between 13% and 18%: Survey 1 (May 8 to 12), Survey 2 (May 29 to June 1), Survey 3 (June 19 to 23), Survey 4 (July 10 to 14), Survey 5 (September 18 to 22), and Survey 6 (November 27 to December 1). Two surveys were conducted in 2021: Survey 7 (March 19–23) and Survey 8 (July 9–13), with response rates of approximately 16% and 13%, respectively. The last survey was conducted between January 7 and 11, 2022, with a response rate of around 10%. Table S1 of the supplement contains additional details of the survey waves.

The survey data were collapsed into four periods corresponding to four of the five major COVID-19 infection

waves in Canada [59, 60], as follows: first wave from January 5 to July 17, 2020, corresponding with alpha as the major variant (Surveys 1 to 4); second wave from July 18, 2020 to March 4, 2021, corresponding with beta as the major variant (Surveys 5 to 6); third wave from March 5 to July 21, 2021, corresponding with gamma as the major variant (Surveys 7 to 8); and fifth wave from November 4, 2021 to February 28, 2022, corresponding with omicron as the major variant (Survey 9). Notably, data was not collected during the fourth wave of COVID-19 between July 23, 2021, and November 3, 2021. We constructed and analyzed pooled samples for each of the COVID-19 waves, examining variations in alcohol and cannabis use and their associations with cohorts of participants' SES over time. These variations may be due to the implemented public health responses (e.g., lockdowns, stay-at-home orders, physical distancing, remote learning, and vaccination programs). We acknowledge that this analysis is exploratory, and an evaluation of the impact of government interventions during the pandemic is beyond the scope of this paper.

Measures

Four alcohol and cannabis use measures were derived from self-reported questionnaires based on the past week's alcohol and cannabis use. A binary variable indicating heavy episodic drinking (HED) was derived based on the question, "On how many of the past seven days did you drink four (if a woman) or five (if a man) or more drinks on one occasion?" Men who consumed five or more drinks and women who consumed four or more drinks per occasion were classified as engaging in HED [61, 62]. A drink was defined as containing 13.45 g of ethanol (i.e., a 12 oz. bottle of beer or cider/cooler (with 5% alcohol content), a 5 oz. glass of wine (with 12% alcohol content), or a straight or mixed drink with 1.5 oz. of liquor (with 40% alcohol content)). We selected HED because it more accurately reflects the risk of both acute and long-term harm. Additionally, HED is a stronger predictor of alcohol-related disorders. In contrast, the past seven-day alcohol use measure does not adequately capture risky drinking behaviours and can be affected by moderate drinking patterns. To evaluate whether a participant's alcohol consumption increased due to the pandemic, we used the question, "In the past seven days, did you drink more alcohol, about the same, or less alcohol overall than you did before the COVID-19 pandemic started?" Based on their responses, we created a binary variable indicating a self-reported increase in alcohol use, with values of 0 (much less, slightly less, or the same) and 1 (slightly more or much more).

Cannabis use indicators were derived using similar questions as alcohol use, "During the past seven days, on how many days did you use cannabis?" We created a

binary variable to indicate cannabis use (any use on one or more days) versus no cannabis use in the past week. This was the only measure of cannabis use captured by the survey, which limited our ability to assess risky behaviours in cannabis consumption. Self-reported/perceived increases in cannabis use were measured using the question, “In the past 7 days, did you use cannabis more often, about the same, or less often overall than you did before the COVID-19 pandemic started?” To indicate an increase in cannabis use, we coded responses as follows: 0 (much less, slightly less, or same), and 1 (slightly more or much more).

Measures of SES included educational attainment (high school diploma or less as the reference category, some post-secondary, college degree/diploma, and university degree/diploma), employment status during the pandemic (employed as the reference category, unemployed, and other impacts on employment (i.e., participants returned to their usual workplace after working from home due to the pandemic, or those who were unemployed, laid off, or let go due to the pandemic were back with either the same or a new employer), and household income (less than \$40,000 as the reference category, \$40,000 to \$79,999, \$80,000 to \$119,999, \$120,000 or more, and ‘prefer not to answer’).

Furthermore, several covariates were examined: gender (men [reference] and women; transgender and gender-diverse people were excluded due to the small sample size), age (18 to 39 [reference], 40 to 59, and ≥ 60 years), and ethnoracial background (White [reference], and racial and ethnic minority groups (i.e., Asian/Black/Indigenous/Arab/Latinx and other ethnicities)). Note that we aggregated Asian, Black, Indigenous, Arab, Latinx, and other ethnicities into racial and ethnic minority groups to create a binary ethnoracial background variable. This was necessary because some interaction terms between SES variables and ethnoracial background categories contained a small number of observations, resulting in large confidence intervals and imprecise estimates. We adjusted all estimates for marital status (single [reference], married/living with a partner, and separated/divorced/widowed), rurality/urbanicity of residence (rural [reference], urban, and suburban), and province or territory indicator variables.

Statistical analyses

Trend analysis

The proportion of respondents who reported engaging in HED, using cannabis at least once in the past week, and increasing alcohol and cannabis use were estimated for each of the four waves of the pandemic across socio-economic subgroups (i.e., education level, employment status during COVID-19, and household income). We used Stata’s test for trends across ordered groups developed

based on a method described in Cuzick (1985) [63]; each group represents a pandemic wave. This test extends the Wilcoxon rank-sum test and accounts for the order in which the waves appeared over time [63, 64]. This test was used to check for trends of substance use across the four successive waves (i.e., test for equality of proportions across waves). We tested the null hypothesis that the proportions are equal across the pandemic waves. A p-value less than 0.05 suggests that the proportions differed across the pandemic waves. The test was performed using Stata `npntrend` command [65].

Regression analysis

We used a multivariable logistic regression model on the pooled data from May 2020 to January 2022 to assess the associations of SES with alcohol and cannabis use. We also examined how each SES indicator interacted with gender, ethnoracial background, and age group and for associations with alcohol and cannabis use during the pandemic. We employed a backward stepwise regression method to iteratively remove interaction terms that were not statistically significant at 5% significance level. Additionally, we adjusted for multiple comparisons using Bonferroni’s method, and adjusted odds ratios (aORs) with Bonferroni-adjusted 95% confidence intervals (CIs) were reported. Analyses were conducted using Stata version 16.1 (StataCorp, College Station, Texas 77845 USA).

Results

Of the 8,943 participants across the nine surveys (after excluding 83 transgender and gender-diverse people), just under half were interviewed in the first wave of the pandemic, about one-quarter in the second and third waves, and just over one-tenth in the fifth wave (Table 1). The distribution of participant characteristics was relatively similar across waves (i.e., men and women were almost equally represented, the approximate split in ethnoracial representation was 70% White persons and 30% ethnic minority groups, slightly fewer than two-thirds were married/living with a partner, and slightly fewer than half lived in an urban environment). The proportion of participants aged ≥ 60 years remained stable, while the fifth wave participants included 5% fewer individuals between 18 and 39 and 10% more between 40 and 59 years old.

Trends in alcohol and cannabis use among socio-economic subgroups

Tables 2, 3, 4 and 5 present trends in HED, perceived increases in alcohol consumption, and cannabis use, as well as perceived increases in cannabis use, during the pandemic by SES across waves (except for the fourth wave, for which data were not available), with the p-values of tests for equality of proportions across the waves.

Table 1 Descriptive statistics: characteristics of the participants across pandemic waves

	Alpha (first wave)	Beta (second wave)	Gamma (third wave)	Omicron (fifth wave)	p-value
	% (n)	%(n)	%(n)	%(n)	-
Total	44.5(3984)	22.3(1990)	22.1(1979)	11.1(990)	-
Gender					
Man	50.2(2000)	49.7(989)	50.1(991)	49.2(487)	0.680
Woman	49.8(1984)	50.3(1001)	49.9(988)	50.8(503)	0.680
Age group					
18 to 39 years	38.9(1550)	38.7(770)	38.8(768)	33.4(331)	0.025
40 to 59 years	30.7(1223)	30.6(609)	30.4(602)	40.2(398)	0.000
≥ 60 years	30.5(1215)	30.8(613)	30.8(610)	26.4(261)	0.099
Ethnoracial background and ethnic minority groups					
White	71.2(2771)	71.5(1389)	70.9(1362)	69.4(666)	0.180
Racial	28.8(1121)	28.5(553)	29.1(559)	30.6(293)	0.180
Arab	4.5(50)	5.2(29)	5.5(31)	4.4(13)	
Asian	67.4(755)	69.8(386)	61(341)	64.5(189)	
Black	12.4(139)	11.2(62)	14(78)	13.7(40)	
Indigenous	4.5(50)	4(22)	6.1(34)	6.8(20)	
Latinx	3.3(37)	3.1(17)	4.3(24)	2.7(8)	
Other	8(90)	6.7(37)	9.1(51)	7.8(23)	
Rurality/urbanicity of residence					
Rural	16.0(637)	16.3(324)	16.7(330)	12.4(123)	0.130
Urban	46.7(1861)	46.7(929)	46.2(914)	49.2(487)	0.424
Suburban	37.3(1486)	37.0(736)	37.0(732)	38.4(380)	0.750
Marital status living with a partner					
Single	24.7(972)	23.0(452)	23.4(457)	23.1(226)	0.177
Married/	62.6(2463)	65.4(1284)	63.0(1232)	63.9(626)	0.472
Separated/divorced/widowed	12.7(500)	11.7(230)	13.6(266)	13.0(127)	0.446

Racial and ethnic minority groups = Asian/Black/Indigenous/Arab/Latinx and other ethnicities

The trends are illustrated graphically in Figures S1-S4 of the supplement.

The proportions of individuals who reported engaging in HED remained stable across waves within all the SES subgroups (Table 2). However, the proportion of individuals who reported an increase in alcohol consumption during the pandemic declined significantly across the first, second, third and fifth waves among participants with higher household incomes, as shown in Table 3. A similar downward trend in perceived increase in alcohol was observed among participants who held a college degree or a university degree, who were employed during

the pandemic, and those who reported other impacts of COVID-19 on their work.

Overall, Table 3 depicts a significant downward trend across waves of the pandemic in self-reported increased alcohol use among people with household incomes between \$80,000 to \$119,999 or ≥\$120,000 or high educational attainment (college or university degree).

Table 4 shows an upward trend in cannabis use at least once a week during the past week for individuals in high-income households (i.e., ≥\$120,000) – from 10.6% to 14.7%. A similar trend was observed in individuals who reported being employed during the pandemic regarding cannabis use. No significant trend was found for self-reported increased cannabis use; that is, there was no significant difference in the proportion of participants reporting an increase in cannabis use across waves among socio-economic subgroups (Table 5).

Associations of SES with alcohol and cannabis use

Tables 2, 3, 4 and 5 present the aORs and 95% CI for SES variables and their interactions with gender, ethnoracial background, and age in explaining the likelihood of alcohol and cannabis use, respectively.

Factors associated with alcohol use/perceived increases in alcohol use

Participants with a household income of \$80,000 to \$119,999, and ≥\$120,000 had 46% and 52% greater odds, respectively, of engaging in HED compared to individuals in households with an income of less than \$40,000. Unemployed individuals had a greater likelihood of engaging in HED than those who were employed.

Additionally, the odds of reporting an increase in alcohol use for individuals with a household income of \$40,000 to \$79,999 and \$80,000 to \$119,999 were 1.27 and 1.51 times greater than those of individuals with a household income of less than \$40,000. Individuals who completed a college and a university degree were at greater odds of reporting an increase in alcohol use than those with a high school diploma. Unemployed people were at greater odds of reporting an increase in alcohol use than those who were employed during the pandemic.

Associations of the intersections of SES and gender, ethnoracial background, and age with alcohol use/perceived increases in alcohol use

Women who hold a university degree were 41% less likely to report engaging in HED compared to men with only a high school diploma. Similarly, individuals aged ≥60 years with a college degree were also 43% less likely to engage in HED compared to those aged 18 to 39 years with a high school diploma. In contrast, racial and ethnic minorities with a household income between \$40,000 and \$79,999 had 1.42 times greater odds of engaging in

Table 2 Trends of alcohol use and its associations with socio-economic status, and their interactions with gender, ethnoraical background, and age

	Heavy episodic drinking					Multivariable Logistic
	Trend analysis					
	Alpha (first wave)	Beta (second wave)	Gamma (third wave)	Omicron (fifth wave)	Trend test p-value	
	%(n)	%(n)	%(n)	%(n)		aOR (Bonferroni 95% CI)
Total	25.6 (3,972)	25.6 (1,983)	25.9 (1,973)	25.4 (988)	0.929	
<i>Household Income</i>						
Income: less than \$40,000	21.3(106)	20.1(45)	24.3(58)	20.7(22)	0.670	Reference
Income: \$40,000-\$79,999	27.8(269)	29(137)	25.8(127)	23.6(61)	0.158	1.54(1.33, 1.79)
Income: \$80,000-\$119,999	27.5(243)	29.4(140)	24.6(112)	31.2(64)	0.924	1.46(1.26, 1.69)
Income: \$120,000+	28.9(281)	26.3(125)	31.8(155)	26.1(76)	0.929	1.52(1.31, 1.76)
Income: missing	17.8(116)	18(60)	19.7(59)	22(28)	0.240	
<i>Education</i>						
High school	27.2(125)	26.3(57)	26.2(70)	20.4(23)	0.243	Reference.
Post-secondary	25.8(161)	30.7(90)	22.9(66)	28.1(39)	0.935	0.96(0.80, 1.16)
College	27.8(219)	26.3(105)	25.4(100)	29(60)	0.825	0.99(0.82, 1.19)
University	24.5(507)	23.9(253)	27.1(274)	24(125)	0.494	0.82(0.70, 0.96)
<i>Employment situation during COVID-19</i>						
Employed	24.7(803)	25.6(441)	25.5(443)	24.8(217)	0.679	Reference
Unemployed	29.7(150)	31(49)	32.5(41)	32.8(23)	0.458	1.33(1.13, 1.56)
Other impact on employment	29(63)	17.3(18)	23.8(26)	25.6(11)	0.325	1.10(0.89, 1.38)
<i>Gender, age, ethnoraical background group</i>						
Man						Reference
Woman						0.72(0.65, 0.79)
18 to 39 years						Reference
40 to 59 years						0.87(0.78, 0.98)
≥ 60 years						0.58(0.49, 0.68)
White						Reference
Racial and ethnic minority groups						0.92(0.81, 1.04)
<i>Interaction terms</i>						
High school x Men						Reference
University x Women						0.59(0.45, 0.75)
High school x 18 to 39 years						Reference
College x ≥ 60 years						0.57(0.40, 0.82)
<\$40,000 x White						Reference
Income: \$40,000 to \$79,999 x racial and ethnic minority groups						1.42(1.08, 1.87)

Employment situation during COVID-19=employed (no change due to the pandemic), unemployed (no change due to the pandemic), and other impacts on employment (i.e., participants working from home due to the pandemic and returning to their usual workplace or participants who were unemployed/laid off/let go due to the pandemic who were back working with the same or a new employer). Odds ratios adjusted for marital status, rurality/urbanicity of residence, and province or territory indicator variables. Racial and ethnic minority groups=Asian/Black/Indigenous/Arab/Latinx and other ethnicities

Statistically significant Odds ratios are in bold (Bonferroni adjusted p -value < 0.05)

HED compared to White individuals from households with an income of less than \$40,000.

Furthermore, women in households with an income of ≥\$120,000 were 84% more likely to report an increase in alcohol use during the pandemic compared to men in households with an income of less than \$40,000. Similarly, individuals aged 40 to 59 years in households with an income of ≥\$120,000 were 92% more likely to report a perceived increase in alcohol use than those aged 18

to 39 years from households with an income of less than \$40,000.

Factors associated with cannabis use/perceived increases in cannabis use

Individuals with a household income between \$40,000 and \$79,999 and those with an income between \$80,000 and \$119,999 had odds of reporting increased cannabis use during the pandemic that were 68% and 77% higher,

Table 3 Trends of perceived increases in alcohol use and its associations with socio-economic status, and their interactions with gender, ethnoracial background, and age

	Perceived increases in alcohol use					Multivariable Logistic
	Trend analysis					
	Alpha (first) wave	Beta (second) wave	Gamma (third) wave	Omicron (fifth) wave	Trend test p-value	
	%(n)	%(n)	%(n)	%(n)		aOR (Bonferroni 95% CI)
Total	22.9 (3,984)	18.7 (1,990)	18.2 (1,979)	17.4 (990)	0.000	
<i>Household Income</i>						
Income: less than \$40,000	15.6(78)	12.1(27)	13.4(32)	12.3(13)	0.253	Reference
Income: \$40,000-\$79,999	21.0(204)	16.9(81)	16.2(80)	17.0(44)	0.026	1.27(1.09, 1.49)
Income: \$80,000-\$119,999	26.2(232)	20.3(97)	18.5(84)	19.5(40)	0.001	1.51(1.29, 1.77)
Income: \$120,000+	29.2(284)	24.2(115)	24.6(120)	20.5(60)	0.002	1.58(1.28, 1.96)
Income: missing	17.5(115)	15.8(53)	14.8(45)	11.7(15)	0.083	
<i>Education</i>						
High school	15.6(72)	11.1(24)	16.9(45)	10.6(12)	0.537	Reference.
Post-secondary	20.8(130)	16(47)	15.9(46)	17.3(24)	0.087	1.22(0.98, 1.53)
College	23.9(189)	19.2(77)	17.5(69)	14.4(30)	0.000	1.35(1.10, 1.67)
University	25.0(519)	20.9(222)	19.6(199)	19.9(104)	0.000	1.46(1.21, 1.77)
<i>Employment situation during COVID-19</i>						
Employed	22.4(731)	18.4(318)	18.2(317)	17.3(152)	0.000	Reference
Unemployed	26.6(134)	23.9(38)	23.0(29)	20.0(14)	0.166	1.38(1.16, 1.64)
Other impact on employment	21.6(47)	16.2(17)	12.6(14)	13.9(6)	0.042	0.96(0.75, 1.23)
<i>Gender, age, ethnoracial background group</i>						
Man						Reference
Woman						0.99(0.88, 1.11)
18 to 39 years						Reference
40 to 59 years						0.89(0.77, 1.04)
≥ 60 years						0.62(0.53, 0.72)
White						
Racial and ethnic minority groups						0.67(0.59, 0.76)
<i>Interaction terms</i>						
<\$40,000 x White						Reference
Income: \$40,000 to \$79,999 x racial and ethnic minority groups						1.42(1.08, 1.87)
Income less than \$40,000 x Men						Reference
Income: ≥\$120,000 x Women						1.84(1.39, 2.43)
Income: <\$40,000 x 18 to 39 years						Reference
Income: ≥\$120,000 x 40 to 59 years						1.92(1.45, 2.56)

Employment situation during COVID-19=employed (no change due to the pandemic), unemployed (no change due to the pandemic), and other impacts on employment (i.e., participants working from home due to the pandemic and returning to their usual workplace or participants who were unemployed/laid off/let go due to the pandemic who were back working with the same or a new employer). Odds ratios adjusted for marital status, rurality/urbanicity of residence, and province or territory indicator variables. Racial and ethnic minority groups=Asian/Black/Indigenous/Arab/Latinx and other ethnicities

Statistically significant Odds ratios are in bold (Bonferroni adjusted p -value < 0.05)

respectively, compared to those with a household income of less than \$40,000.

Associations of the intersections of SES and gender, ethnoracial background, and age with cannabis use/perceived increases in cannabis use

Women with university degrees had odds of reporting the use of cannabis at least once per week that were 64% lower than those of men with high school diplomas.

Individuals aged 40 to 59 years with a university degree, older adults (≥ 60 years) with a post-secondary education level, college degree, or university degree had odds of reporting cannabis use that were between 72% and 92% lower than those of individuals aged 18 to 39 years with a high school diploma. Older adults who were unemployed or reported other impacts in their employment situation had odds of reporting cannabis use that were 80% to 87% lower than those of individuals aged 18 to 39 years

Table 4 Trends of cannabis use and its associations with socio-economic status, and their interactions with gender, ethnoracial background, and age

	Cannabis use					Multivariable Logistic
	Trend analysis					
	Alpha (first wave)	Beta (second wave)	Gamma (third wave)	Omicron (fifth wave)	Trend test p-value	
	%(n)	%(n)	%(n)	%(n)		aOR (Bonferroni 95% CI)
<i>Total</i>	12.4 (3,975)	13.8 (1,985)	12.8 (1,974)	14.3 (988)	0.176	
<i>Household Income</i>						
Income: less than \$40,000	13.6(67)	19.3(43)	12.9(31)	12.3(13)	0.753	Reference
Income: \$40,000–\$79,999	15(145)	15.5(74)	14.4(71)	18.2(47)	0.446	1.35(1.08, 1.69)
Income: \$80,000–\$119,999	15(133)	17.2(82)	14.7(67)	14.1(29)	0.762	1.40(1.10, 1.79)
Income: \$120,000+	10.6(103)	10.5(50)	12.3(60)	14.7(43)	0.025	1.15(0.89, 1.49)
Income: missing	6.8(45)	7.5(25)	8(24)	7.1(9)	0.657	
<i>Education</i>						
High school	13(60)	16.7(36)	16.5(44)	12.4(14)	0.545	Reference.
Post-secondary	14.1(88)	17.3(51)	14.5(42)	19.6(27)	0.216	1.09(0.82, 1.45)
College	14.9(117)	17.8(71)	14.7(58)	16.8(35)	0.651	1.15(0.87, 1.51)
University	10.9(226)	10.7(114)	10.6(107)	12.3(64)	0.622	0.55(0.41, 0.74)
<i>Employment situation during COVID-19</i>						
Employed	11.6(378)	12.9(222)	12.8(223)	14.2(125)	0.038	Reference
Unemployed	15.3(77)	26.4(42)	13.6(17)	15.9(11)	0.777	1.33(0.99, 1.80)
Other impact on employment	17.1(37)	8.6(9)	12.8(14)	11.9(5)	0.199	0.89(0.57, 1.38)
<i>Gender, age, ethnoracial background group</i>						
Man						Reference
Woman						0.66(0.57, 0.75)
18 to 39 years						Reference
40 to 59 years						0.50(0.43, 0.59)
≥ 60 years						0.15(0.07, 0.29)
White						Reference
Racial and ethnic minority groups						0.72(0.62, 0.84)
<i>Interaction terms</i>						
High school x Men						Reference
University x Women						0.36(0.23, 0.57)
High school x 18 to 39 years						Reference
College x 40 to 59 years						-
University x 40 to 59 years						0.28(0.17, 0.44)
Post-secondary x ≥ 60 years						0.16(0.06, 0.46)
College x ≥ 60 years						0.17(0.06, 0.48)
University x ≥ 60 years						0.08(0.03, 0.24)
Employed x 18 to 39 years						Reference
Unemployed x ≥ 60 years						0.20(0.07, 0.59)
Other impact x ≥ 60 years						0.13(0.04, 0.49)
High school x White						Reference
University x racial and ethnic minority groups						0.40(0.26, 0.62)
Income: <\$40,000 x 18 to 39 years						Reference
Income: \$40,000 to \$79,999 x ≥ 60 years						0.20(0.07, 0.56)
Income: \$80,000 to \$119,999 x ≥ 60 years						0.21(0.07, 0.59)
Income: ≥\$120,000 x ≥ 60 years						0.17(0.06, 0.48)

Employment situation during COVID-19=employed (no change due to the pandemic), unemployed (no change due to the pandemic), and other impacts on employment (i.e., participants working from home due to the pandemic and returning to their usual workplace or participants who were unemployed/laid off/let go due to the pandemic who were back working with the same or a new employer). Odds ratios adjusted for marital status, rurality/urbanicity of residence, and province or territory indicator variables. Racial and ethnic minority groups = Asian/Black/Indigenous/Arab/Latinx and other ethnicities

Statistically significant Odds ratios are in bold (Bonferroni adjusted p-value < 0.05)

Table 5 Trends of perceived increases in cannabis use and its associations with socio-economic status, and their interactions with gender, ethnoracial background, and age

	Perceived increases in cannabis use					Multivariable Logistic
	Trend analysis					
	Alpha (first wave)	Beta (second wave)	Gamma (third wave)	Omicron (fifth wave)	Trend test p-value	
	%(n)	%(n)	%(n)	%(n)		aOR (Bonferroni 95% CI)
<i>Total</i>	6.3 (3,984)	7.2 (1,990)	5.9 (1,979)	6.9 (990)	0.883	
<i>Household Income</i>						
Income: less than \$40,000	6.2(31)	10.7(24)	6.3(15)	4.7(5)	0.751	Reference
Income: \$40,000-\$79,999	7.9(77)	7.7(37)	7.1(35)	8.1(21)	0.817	1.68(1.29, 2.17)
Income: \$80,000-\$119,999	8.6(76)	10.1(48)	6.2(28)	7.3(15)	0.199	1.77(1.36, 2.30)
Income: \$120,000+	5(49)	6.1(29)	6.2(30)	7.2(21)	0.148	1.22(0.92, 1.63)
Income: missing	2.6(17)	1.8(6)	2.6(8)	4.7(6)	0.363	
<i>Education</i>						
High school	6.7(31)	5.1(11)	8.6(23)	7.1(8)	0.435	Reference
Post-secondary	8.2(51)	11.2(33)	5.5(16)	7.9(11)	0.950	1.22(0.88, 1.68)
College	6.1(48)	7.7(31)	6.6(26)	5.8(12)	0.765	0.91(0.61, 1.37)
University	5.8(120)	6.5(69)	4.9(50)	7.1(37)	0.240	0.45(0.30, 0.68)
<i>Employment situation during COVID-19</i>						
Employed	5.7(186)	6.5(112)	5.7(99)	7.1(62)	0.297	Reference
Unemployed	8.7(44)	18.2(29)	7.9(10)	5.7(4)	0.829	1.50(0.92, 2.45)
Other impact on employment	9.2(20)	2.8(3)	6.3(7)	4.6(2)	0.175	0.52(0.18, 1.54)
<i>Gender, age, ethnoracial background group</i>						
Man						Reference
Woman						0.70(0.59, 0.84)
18 to 39 years						
40 to 59 years						0.32(0.19, 0.54)
≥ 60 years						0.07(0.02, 0.21)
White						Reference
Racial and ethnic minority groups						0.83(0.68, 1.01)
<i>Interaction terms</i>						
High school x Men						
University x Women						0.32(0.17, 0.59)
High school x 18 to 39 years						Reference
College x 40 to 59 years						0.29(0.11, 0.75)
University x 40 to 59 years						0.14(0.06, 0.36)
Post-secondary x ≥ 60 years						-
College x ≥ 60 years						0.06(0.01, 0.31)
University x ≥ 60 years						0.03(0.01, 0.16)
Employed x 18 to 39 years						Reference
Unemployed x ≥ 60 years						0.10(0.02, 0.64)
Other impact x ≥ 60 years						0.04(0.01, 0.57)
High school x White						Reference
University x racial and ethnic minority groups						0.37(0.21, 0.68)

Employment situation during COVID-19= employed (no change due to the pandemic), unemployed (no change due to the pandemic), and other impacts on employment (i.e., participants working from home due to the pandemic and returning to their usual workplace or participants who were unemployed/laid off/let go due to the pandemic who were back working with the same or a new employer). Odds ratios adjusted for marital status, rurality/urbanicity of residence, and province or territory indicator variables. Racial and ethnic minority groups= Asian/Black/Indigenous/Arab/Latinx and other ethnicities

Statistically significant Odds ratios are in bold (Bonferroni adjusted p-value < 0.05)

with jobs. During the pandemic, individuals from racial and ethnic minority groups with a university degree were 60% less likely to use cannabis than were White individuals with a high school diploma. Additionally, older adults with a moderate/high household income of \$40,000 to \$79,999, \$80,000 to \$119,999, and \geq \$120,000 had odds of reporting cannabis use that were between 80% and 83% lower than those of individuals aged 18 to 39 years with a household income of less than \$40,000.

Regarding perceived increases in cannabis use, women with university degrees were 68% less likely to report increased use of cannabis than men with high school diplomas. Individuals aged 40 to 59 years with a university degree or college degree had odds of reporting an increase in cannabis use that were 71% to 86% lower than those of individuals aged 18 to 39 years with a high school diploma. Older adults with a university degree or college degree had 94% to 97% lower odds of reporting increased cannabis use compared to individuals aged 18 to 39 years with a high school diploma. Older adults who were unemployed had 90% lower odds of reporting increased use of cannabis than individuals aged 18 to 39 years with jobs. Finally, individuals in racial and ethnic minority groups with a university degree were 63% less likely to report increased use of cannabis than were White individuals with a high school diploma.

Discussion

Socio-economic factors related to changes in alcohol use

The proportions of individuals who reported engaging in HED remained stable across pandemic waves within most socio-economic subgroups, showing that participants had kept a relatively steady drinking behaviour over time. This suggests that people may have been able to initiate some coping efforts, allowing them to mitigate the effect of stress while not engaging in HED to cope, as indicated by the transactional model of stress and coping [66]. Additionally, the downward trend of perceived increases in alcohol use among participants with moderate to high household incomes, high educational attainment, and a job could be partly explained by the conservation of resources theory [67], since these subgroups represent high SES and did not experience a significant loss of resources during COVID-19 to increase their levels of stress. An alternative explanation may be that during the pandemic, people may have experienced reduced financial resources (e.g., income loss and/or reduced work hours) and limited access to alcohol (e.g., restaurant and bar closures and social and physical distancing led to reduced alcohol drinking occasions) [4, 68, 69]. Another potential explanation for this reduction could be that coping-motivated drinking was initially high during the first wave but decreased as people adopted other coping mechanisms to mitigate the effects

of COVID-19-related changes on their overall mental health (e.g., physical activity, telemedicine, virtual peer support groups, and discussion forums) [70, 71].

We found that participants with a moderate or high household income and those who were unemployed during the pandemic were more likely to be heavy episodic drinkers and to self-report an increase in their alcohol drinking during the pandemic. This is consistent with the results of a nationally representative survey, which indicated that self-reported increased alcohol consumption was augmented by income quintile (ranging from 7.5% to 27.2%) since those who had increased their alcohol consumption during the pandemic were most likely to report frequent heavy drinking [72]. In contrast, our findings suggest that unemployment, including being laid off during the pandemic, is associated with HED and perceived increases in alcohol drinking. This may seem counterintuitive; however, studies that examined harmful drinking after job loss following the 2008 financial crisis have provided a possible explanation for this result [6] – two opposite mechanisms might be at play: income mechanism (i.e., a lower income leads to less drinking) and the self-medication mechanism (i.e., psychological distress leads to more drinking) [6, 73]. During the pandemic in Canada, the income-related mechanism may have been outweighed by the self-medication mechanism.

Our results suggest that the level of education may be a protective factor against risky drinking behaviour during times of stressful events. This is consistent with findings that show that low-level education is a risk factor for post-traumatic stress disorder [57], particularly when COVID-19 is modelled as a traumatic event [15].

We found that individuals from racial and ethnic minority groups with moderate household income were at a greater risk of alcohol use than White persons in households with low income. This result, suggesting racial disparities in substance use during the pandemic, is consistent with racial and ethnic minority groups perceived higher levels of pandemic threat (including health, economic and cultural risk), which in turn is associated with negative affect (including loneliness and grief) [53]. This finding underscores the urgent need to address these disparities and implement targeted interventions that support vulnerable populations in making healthier choices regarding alcohol consumption during stressful events.

Socio-economic factors related to changes in cannabis use

Among participants in high-income households (\geq \$120,000) and those who reported having employment during the pandemic, the proportions of individuals using cannabis at least once a week increased significantly across pandemic waves. This result suggests that trends in cannabis use were different across socio-economic

subgroups. However, no significant trends were found among educational levels. The latter observation was corroborated by a previous study using the same dataset, covering shorter periods and lesser waves of the pandemic (8 vs. 21 months) [74]. We expanded this previous study by examining trends in other dimensions of SES (i.e., income and employment).

Similar to alcohol use, high education level and having or maintaining moderate/high household income during the pandemic were protective factors against the use/perceived increased use of cannabis for women and older adults. This may be explained by the fact that when people can maintain a high SES, they are at lower risk for psychological distress during stressful and traumatic situation [54, 75]. Although many studies found that during the pandemic, racial and ethnic minority groups were at greater odds of using cannabis frequently in response to elevated anxiety and depression during COVID-19 [56, 76, 77], we found that among these minority groups those who held a university degree were less likely to use cannabis or report increased use of cannabis during the pandemic than White individuals with a high school diploma. This result highlights the importance of intersectional consideration in accurately identifying vulnerable populations, ensuring that interventions and programs are offered to those in genuine need.

Limitations

This study has several limitations. Although quota sampling is a relatively inexpensive and easy-to-conduct non-probability sampling method [78], it may not fully represent the population due to its non-random nature, which can lead to selection and participation biases [79]. Concerns about such biases may be especially pertinent when response rates are low (i.e., 10 to 17%), as was the case with the surveys used in this study, given that internet access was required to participate. Furthermore, individuals with substance use problems are generally less likely to engage in research, which may result in underestimating the prevalence of alcohol and cannabis use. Additionally, the quota sampling was designed to be representative of English-speaking Canadians, which means that French-speaking populations in Quebec and French-only speakers outside of Quebec were likely underrepresented in the study [80]. This limitation, coupled with the study's non-probabilistic nature, indicates that the findings may not be generalizable to the entire Canadian population. Moreover, the study was not designed to analyze provincial-level data, preventing an examination of whether and how inter-provincial variations in alcohol and cannabis policies and regulations [81–83] and in public health restrictions [59] may have affected an individual's use of cannabis and alcohol.

Changes in alcohol and cannabis use during the pandemic were measured through participants' subjective assessment of their consumption over the past seven days. Participants were asked whether their use of alcohol or cannabis was greater than, less than, or equal to their consumption prior to the pandemic. Several factors complicate the measurement of changes in substance use. Firstly, the evaluation of changes in alcohol consumption relies on subjective measurements rather than objective, longitudinal data. This reliance on personal assessment may lead to varying interpretations of what constitutes an increase or decrease, and it is also prone to recall bias, which can result in an underestimation of alcohol and cannabis use before the pandemic [84, 85]. This recall bias would be exacerbated with each wave of the Asking Canadians Delvina survey, as participants must recall increasingly distant events (i.e., alcohol and cannabis use before the pandemic). Secondly, underlying seasonal trends in the population's use of alcohol and cannabis have been observed, with alcohol use highest during the summer and during holidays [85, 86] and cannabis use is highest in the summer and fall [87]. Suppose a survey participant does not consider these seasonal trends. In that case, their responses regarding changes in alcohol and cannabis use, particularly in relation to the period before the pandemic, may be influenced by these seasonal fluctuations.

Finally, as with all cross-sectional surveys, conclusions regarding causal relationships could not be made. Nevertheless, our study underlines the importance of long-term monitoring of trends in alcohol and cannabis use. It identifies subgroups of the population with an increased likelihood of cannabis and alcohol use.

Conclusions

These findings highlight the importance of accounting for interactions between SES and gender, ethnoracial background, and age to identify subgroups of individuals with an increased likelihood of substance use. Future public health interventions aimed at reducing the short- and long-term harms due to alcohol and cannabis use during the pandemic should be tailored to different population segments to ensure that the more vulnerable populations are effectively served. Our findings suggest that before designing, for example, interventions aimed at racial and ethnic minority groups who may be at higher risk for substance use disorders due to risky consumption behaviours, it is imperative to adopt an intersectional approach. This approach should differentiate between SES levels, particularly focusing on racial and ethnic minorities with low SES who are the real at-risk population. Another implication of our findings is that SES can be used to categorize within sociodemographic groups those who are vulnerable, for example, White individuals

with only a high school diploma are more susceptible to risky use of substances than members of racial minorities who hold a university degree.

Abbreviations

COVID-19	Coronavirus disease 2019
SES	Socio-economic status
aOR	Adjusted odds ratio
CI	Confidence interval
RR	Response rate
HED	Heavy episodic drinking

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-25423-z>.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Acknowledgements

The authors acknowledge the in-kind support for data collection provided by Delvinia.

Authors' contributions

JR, SW, KS, SA, and NHS initiated the study. NHS, KS, SW, SI, SA and CdeO conceptualized and designed the study. HAH and TEM developed the survey questionnaires for the data collection. NHS analyzed the data and drafted the manuscript. All co-authors read and critically revised successive drafts of the manuscript. All authors read and approved the final manuscript.

Funding

Delvinia, a research technology firm provided in-kind support for data collection. We did not receive funding from Delvinia; however, they administered our questionnaires to Canadians through their web-based panel AskingCanadians (<https://www.delvinia.com/solutions/askingcanadians>), without charging fees.

Data availability

All data generated or analyzed during this study are included in this published article [and its supplementary information files]. Data are also publicly available for download at: <https://www.delvinia.com/coronavirus/>.

Declarations

Ethics approval and consent to participate

The study has been granted ethics committee approval from the Research Ethics Board at the Centre for Addiction and Mental Health, Toronto, Ontario, Canada. The Centre For Addiction and Mental Health Research Ethics Board (CAMH REB) operates in compliance with, and is constituted in accordance with, the requirements of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2), the International Conference on Harmonization Good Clinical Practice Guideline, Part C, Division 5 of the *Food and Drug Regulations*, Part 4 of the *Natural Health Products Regulations*, Part 3 of the *Medical Devices Regulations*, and the provisions of Ontario's *Personal Health Information Protection Act, 2004* and its applicable regulations. The CAMH REB is qualified through the CTO REB Qualification Program, and is registered with the United States Department of Health and Human Services' Office for Human Research Protections. All participants provided written consent to participate.

Consent for publication

N/A.

Competing interests

The authors declare no competing interests.

Author details

- ¹Ontario Health, Toronto, ON, Canada
- ²Institute of Health Policy, Management and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada
- ³Department of Epidemiology and Biostatistics, Schulich School of Medicine and Dentistry, Western University, 3rd Floor, 1465 Richmond Street, London, ON N6G 2M1, Canada
- ⁴ICES, Toronto, ON, Canada
- ⁵Institute for Mental Health Policy Research, Centre for Addiction and Mental Health, Toronto, ON, Canada
- ⁶Campbell Family Mental Health Research Institute, Centre for Addiction and Mental Health, Toronto, ON, Canada
- ⁷Department of Psychiatry, University of Toronto, Toronto, ON, Canada
- ⁸School of Psychology, Deakin University, Victoria, Australia
- ⁹Schulich Interfaculty Program in Public Health, Schulich School of Medicine and Dentistry, Western University, London, Canada
- ¹⁰Department of Health Sciences, University of York, York, UK
- ¹¹Department of Psychology, Macquarie University, Sydney, Australia
- ¹²Bruyere Research Institute, Ottawa, Canada
- ¹³School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Canada
- ¹⁴Institute for Clinical Psychology and Psychotherapy, TU Dresden, Dresden, Germany
- ¹⁵Institute of Medical Science, University of Toronto, Toronto, ON, Canada

Received: 19 June 2024 / Accepted: 24 October 2025

Published online: 19 November 2025

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