

Article

Changes in Alcohol Consumption in Canada During the COVID-19 Pandemic: Associations With Anxiety and Self-Perception of Depression and Loneliness

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Abstract

Aim: To examine whether changes in alcohol consumption in Canada since the start of the novel coronavirus disease (COVID-19) pandemic are associated with feelings of anxiety, depression, loneliness and/or with changes in employment due to COVID-19.

Methods: Data collection occurred between 29 May 2020 and 23 March 2021 via a web panel, AskingCanadians, which sampled 5892 adults (≥ 18 years of age). Data were collected on changes in alcohol consumption compared to before the pandemic (ordinal variable ranging from 1='much less alcohol' to 5='much more alcohol'), anxiety (General Anxiety Disorder-7), self-perceived depression (Center for Epidemiologic Studies Depression Scale), self-perceived loneliness, changes in employment status due to COVID-19 and socio-demographic variables (age, gender, living situation, household income and urban vs rural residence). Multivariate associations were assessed using ordinal logistic regression. Effect modification by gender was tested using likelihood-ratio tests.

Results: Changes in alcohol consumption were positively associated with anxiety, feeling depressed and loneliness. In particular, people with mild to moderate (ordered Odds Ratio (OR):1.23, 95% Confidence Interval (CI):1.07, 1.62) or severe anxiety (ordered OR:1.49, 95% CI:1.15, 1.93) had a greater odds of increased drinking than did people with no to low levels of anxiety.

Gender, age, household income, living situation and survey wave were also associated with changes in drinking. No effect modifications by gender were observed.

Conclusion: Given the health harms caused by alcohol use, public health practitioners and primary care physicians should focus health messaging to identify and support individuals at risk of increased alcohol consumption, especially people experiencing depression, loneliness or anxiety.

INTRODUCTION

The novel coronavirus disease (COVID-19) was declared a 'public health emergency of international concern' on 30 January 2020 by the World Health Organization (WHO), and, as of 13 July 2020, there were approximately 12.8 million confirmed cases of COVID-19 in 216 countries, areas or territories, with 566,000 confirmed fatalities (World Health Organization 2020b). In Canada, as of 12 July 2020, there were more than 107,000 confirmed COVID-19 cases, and more than 8700 confirmed deaths (Government of Canada 2020). In the absence of pharmacological interventions, all provincial and territorial governments in Canada had declared COVID-19 a public health emergency by mid-April 2020, instituting measures including social-distancing policies to slow the spread of the disease (BC Gov News 2020; Lawrence 2020; Office of the Premier 2020). While such restrictive measures may help to protect physical health, and work to prevent healthcare systems from becoming overwhelmed, such interventions may also have social and economic consequences.

Alcohol consumption was a leading cause of mortality and morbidity in Canada even before the COVID-19 pandemic, particularly among adults 15 to 49 years of age (Rehm et al. 2010; GBD 2016 Alcohol Collaborators 2018; Rehm and Intiaz 2016). Consequently, increased consumption as a result of the current pandemic will likely have immediate and long-term public health consequences, including increasing the transmission and worsening of the disease course of COVID-19 (World Health Organization 2020a), and increasing the already high alcohol-attributable public health burden in Canada (Benzie 2020; Chaudhuri 2020; Zussman 2020). Although a few ad hoc reports from North America have shown increases in alcohol sales during the pandemic (Benzie 2020, Chaudhuri 2020, Zussman 2020), scientific evidence of such increases is sparse, and there is no coordinated policy effort to address a potential looming crisis resulting from this apparent increased consumption of alcohol (Rehm et al. 2020).

Little evidence is available that identifies factors associated with increased drinking during the COVID-19 pandemic. Such information is needed to inform public health and policy efforts to dampen increases in alcohol use during the present and future health crises. Anxiety, depression, loneliness and job loss experienced as a result of a major disease outbreak may lead to increased alcohol consumption (Bolton et al. 2009; Leeies et al. 2010). Furthermore, alcohol consumption motives and context (consuming alcohol on-site and off-site) are associated with gender, age, socio-economic status and rurality (Treno et al. 2000; Collins 2016; Dixon and Chartier 2016); we hypothesized that alcohol consumption would differ by these factors as well.

Accordingly, the aim of this study was to identify factors associated with increases in alcohol consumption in Canada during the COVID-19 pandemic, with a focus on anxiety, depression and loneliness, as well as changes in employment due to the pandemic. Given that stressors appear to have differential effects on the drinking behaviours of men and women (Peltier et al. 2019), this study also examined whether the factors associated with changes in alcohol use differed for men and women.

METHODS

Participants were recruited utilizing web-based panel surveys of adults 18 years of age and older living in Canada. Invitations to participate in the survey were sent to N = 38,962 participants of an existing web panel (AskingCanadians) hosted by the Delvinia research firm. Participants were invited to participate in the surveys based on a quota sampling by age, gender and region (proportional to the English-speaking Canadian population as the surveys were conducted in English).

Cross-sectional data used in our analysis were collected from 29 May to 1 June 2020 (Wave 2), 19 to 23 June (Wave 3), 10 to 14 July (Wave 4), 18 to 22 September (Wave 5), 27 November to 1 December (Wave 6) and 19 to 23 March 2021 (Wave 7). Data from Wave 1 (8 to 12 May 2020) were excluded from this study since changes in alcohol consumption were not measured for people who did not report drinking in the past week in this wave's survey. As these people may have decreased their alcohol consumption, Wave 1 data were not eligible for study inclusion. A total of 38,962 invitations were sent, 571 people were screened for the survey but were unable to participate, and 893 people responded to the survey request but were not sampled due to the respondent's quota being full. The response rate for Waves 2 to 7 combined was 15.7%; the response rates by wave are outlined in Table S1 of the supplemental material. A total of N = 5892 people completed the surveys and answered all questions, data from which were used in our analyses.

Changes in each respondent's alcohol consumption since the start of the COVID-19 pandemic were measured on a 5-point monotonically increasing Likert scale, indicating whether in the past 7 days the respondent drank 'much less alcohol', drank 'slightly less alcohol', experienced 'no change' in alcohol consumption, drank 'slightly more alcohol', or drank 'much more alcohol' compared to before the start of the pandemic.

Symptoms of anxiety were measured using the General Anxiety Disorder-7 (GAD-7) screening tool (Spitzer et al. 2006), which also measures symptom severity for anxiety disorders. All GAD-7 answers were measured using a 4-point Likert scale. Scores were summed across answers to estimate a summary measure of anxiety that has demonstrated high internal consistency (Cronbach's alpha: 0.94; 95% Confidence Interval (CI): 0.94, 0.94). The GAD-7 scores (0–21) were categorized as low (0–4), mild to moderate (5–14) and severe (≥ 15) anxiety. Symptoms of depression were measured by utilizing three questions from the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff 1977). These questions used a past week time frame, questioning participants as to 'how often have you felt depressed?', 'how often have you felt lonely?' and/or 'how often have you felt hopeful about the future?'. These three items were measured using a 4-point Likert scale. The CES-D summary score has poor internal consistency (Cronbach's alpha: 0.59; 95% CI: 0.57, 0.60), and, accordingly, the answers to the CES-D questions were not combined into one summary measure.

For socio-demographic variables, respondents indicated their gender, age, household income, location of residence (urban, suburban or rural) and number of people living in their household. Respondents

were also asked if physical distancing measures due to the COVID-19 pandemic had affected their employment situation.

Statistical analyses

Those factors (i.e. demographic variables, depression symptoms and/or anxiety symptoms) tested for their associations with changes in alcohol consumption (compared to before the start of the COVID-19 pandemic) were selected based on existing theory and literature. The evaluation of whether certain factors were associated with changes in alcohol consumption was determined using chi-square tests. Associations between factors also were assessed using chi-square tests (see Table S8).

To adjust for potential confounding across the examined factors, we measured associations using an ordinal logistic regression analysis, with changes in alcohol use operationalized as an ordinal categorical measure with the lowest category being the reporting of drinking much less alcohol in the past 7 days compared to before the COVID-19 pandemic, and the highest category being the reporting of drinking much more alcohol in the past 7 days compared to before the COVID-19 pandemic. Variable inclusion for the regression models was based on existing theory and literature, as opposed to a data-driven approach. Demographic variables, as well as measures of depression symptoms and/or anxiety symptoms, were included in all regression models. All ordinal logistic regression models were performed for the total sample and separately for men and women. To test for statistical interactions (i.e. effect modification) between genders and other independent variables, likelihood ratio tests were performed comparing the log likelihood statistics of models with interaction terms to those without interaction terms. The proportional log odds assumption was assessed by means of a visual inspection of the plotted log odds. A secondary analysis was performed to determine whether the wave of the survey was significantly associated with changes in alcohol consumption or affected the significance of other variables associated with changes in alcohol consumption. No population expansion weights were used as the sample was repetitive by design and it used quota sampling by age, gender and region.

Anxiety, and self-reported depression, loneliness and hopelessness may be correlated. Thus, multicollinearity may lead to a problem in model fit for these variables. Accordingly, we first examined correlations between categorical variables used in the multivariate regression analyses as measured by chi-square tests to examine if categorical variables were correlated (See Table S8). Secondly, for the total sample, and for women and men separately, we examined the Variance Inflation Factors (VIF) to assess if multicollinearity was a problem; a VIF cut-off point of 5 indicated a high multicollinearity (Hocking and Pendelton 1983). Lastly, we performed a sensitivity analysis to examine if the separate addition of the variables for anxiety (GAD-7 score), number of days feeling depressed, number of days feeling lonely and number of days feeling hopeful about the future resulted in changes in the significance or direction of the model's beta-coefficients. As multicollinearity was hypothesized to exist between four variables, we used a forward regression approach (the addition of each variable separately to the model together with demographic and wave variables) as opposed to a backwards stepwise regression (removal of each variable separately from the full regression model).

All analyses were performed using the statistical software package R, version 4.0.1 (R Core Team 2013). Data are available upon request.

RESULTS

A total of 2937 women, 2911 men and 44 people who did not identify as either a man or a woman participated in the study. Primarily, participants were 30–39 years of age (26.7%), had a household income of more than \$120,000 per year (25.1%), lived with others (79.3%), had experienced a change in employment status due to the COVID-19 pandemic (38.6%), and lived in an urban area (46.5%) (see Table 1).

A total of 59.1% of all participants were current drinkers (based on the past 7 days). Compared to before the COVID-19 pandemic, 6.9% of all survey participants reported drinking much less alcohol, 6.4% reported drinking slightly less alcohol, 16.4% reported drinking slightly more alcohol, 4.3% reported drinking much more alcohol and 66.0% indicated no change in their consumption.

GAD-7 summary scores indicated that 51.6, 39.2 and 9.1% of the participants had no to low, mild to moderate or severe anxiety, respectively (see Table 2). A total of 20.2 and 22.1% of the participants reported that they felt depressed or lonely, respectively, at least three or more days in the past week. Furthermore, a total of 51.5% said they felt hopeful for the future on 0 to 2 days per week.

Bivariate tests indicated that anxiety and the number of days a participant felt depressed, lonely and/or hopeful about the future were significantly associated with changes in alcohol consumption (see Tables S2–S7 in the supplemental material). Gender, age, living situation, household income, changes in employment status and residence were also associated with changes in consumption.

The multivariate ordinal regression models indicated that anxiety and the number of days a respondent felt depressed or lonely were significantly associated with self-reported changes in alcohol consumption, controlling for the socio-demographic variables (see Tables 3 and 4). The ordered Odds Ratios (ORs) are reported below—these should be interpreted as the odds of being in a higher category of change in alcohol use (compared to a lower category of change); these categories ranged from drinking much less to drinking much more alcohol in the past 7 days compared to before the COVID-19 pandemic. The analysis found that people who identify as neither male nor female were more likely to report a higher category of change in alcohol use (and therefore more likely to have an increase in alcohol consumption) compared to people who identified as female (ordered OR: 1.86; 95% CI: 1.01, 3.41). People 30 to 39, 40 to 49, 50 to 59, 60 to 69 and 70 years of age and older were more likely to report a higher category of change in alcohol use than were people 18 to 29 years of age. Individuals who lived with others were more likely to report a higher category of change in alcohol use (ordered OR: 1.19; 95% CI: 1.03, 1.37) than were people who lived alone. People who had an annual income of \$80,000 to <\$120,000 (ordered OR: 1.37; 95% CI: 1.12, 1.67), and \$120,000 or over per year (ordered OR: 1.57; 95% CI: 1.28, 1.93) were more likely to report a higher category of change in alcohol use than were people with incomes of less than \$40,000 per year.

People with mild to moderate anxiety (ordered OR: 1.23; 95% CI: 1.07, 1.42) or severe anxiety (ordered OR: 1.49; 95% CI: 1.15, 1.93) were more likely to report a higher category of change in alcohol use than were people who had low levels of anxiety. People who reported feeling depressed 1 to 2 days (ordered OR: 1.36; 95% CI: 1.17, 1.42), 3 to 4 days (ordered OR: 1.48; 95% CI: 1.20, 1.83) or 5 to 7 days in the previous week (ordered OR: 1.42; 95% CI: 1.04, 1.94) were also more likely to report a higher category of change in alcohol use than were people who did not feel depressed in the past week. People who reported feeling lonely 3 to 4 days in the previous week (ordered OR:

Table 1. Demographic characteristics of the web panel sample, by gender

		Total		Men		Women	
		Prevalence (%)	(95% CI)	Prevalence (%)	(95% CI)	Prevalence (%)	(95% CI)
Gender	Male	49.4	(48.1, 50.7)				
	Female	49.8	(48.6, 51.1)				
	Other	0.7	(0.5, 1.0)				
Age (years)	18 to 29	12.1	(11.3, 13.0)	10.3	(9.2, 11.4)	13.7	(12.5, 15.0)
	30 to 39	26.7	(25.5, 27.8)	28.0	(26.3, 29.6)	25.2	(23.7, 26.8)
	40 to 49	14.4	(13.6, 15.4)	14.5	(13.2, 15.8)	14.3	(13.1, 15.7)
	50 to 59	16.2	(15.3, 17.2)	16.3	(15.0, 17.7)	16.2	(14.9, 17.6)
	60 to 69	18.6	(17.6, 19.6)	18.1	(16.8, 19.6)	19.3	(17.9, 20.8)
	70 and older	11.9	(11.1, 12.8)	12.8	(11.6, 14.1)	11.2	(10.1, 12.4)
Living situation	Live alone	20.7	(19.7, 21.7)	19.8	(18.4, 21.3)	21.5	(17.8, 20.7)
	Live with someone else	79.3	(78.3, 80.3)	80.2	(78.7, 81.6)	78.5	(35.8, 39.4)
Household income (per year)	<\$40,000	11.9	(11.1, 12.8)	10.9	(9.7, 12.0)	12.9	(11.7, 14.2)
	40,000 to 79,000	24.0	(23.0, 25.2)	23.5	(22.0, 25.1)	24.5	(23.0, 26.1)
	\$80,000 to \$119,000	23.2	(22.1, 24.3)	25.8	(24.3, 27.5)	20.7	(19.2, 22.2)
	\$120,000 and over	25.1	(24.0, 26.2)	27.9	(26.3, 29.6)	22.5	(21.0, 24.1)
	Prefer not to answer	15.7	(14.8, 16.7)	11.9	(10.7, 13.1)	19.4	(18.0, 20.9)
Changes in employment status	No change	10.0	(9.2, 10.8)	10.3	(9.3, 11.5)	9.7	(8.6, 10.8)
	Unemployed	9.3	(8.6, 10.1)	9.8	(8.7, 10.9)	8.8	(7.8, 9.9)
	Newly employed	4.7	(4.2, 5.3)	4.2	(3.5, 4.9)	5.2	(4.4, 6.1)
	Student / retired	26.8	(25.7, 28.0)	23.5	(21.9, 25.0)	30.3	(28.6, 32.0)
	Working from home	24.6	(23.5, 25.7)	26.2	(24.6, 27.8)	23.0	(21.5, 24.5)
	Other	24.6	(23.5, 25.7)	26.1	(24.5, 27.7)	23.1	(21.6, 24.7)
Residence	Urban	46.5	(45.2, 47.8)	49.8	(48.0, 51.6)	43.2	(41.4, 45.0)
	Suburban	37.2	(36.0, 38.5)	36.9	(35.2, 38.7)	37.6	(35.8, 39.4)
	Rural	16.3	(15.4, 17.3)	13.3	(12.0, 14.5)	19.2	(17.8, 20.7)

1.24; 95% CI: 1.02, 1.50) or 5 to 7 days in the previous week (ordered OR: 1.51; 95% CI: 1.16, 1.96) were more likely to have a higher category of change in alcohol use than were people who did not feel lonely in the past week. No significant differences in the ordered ORs were observed by changes in employment status, residence location or the number of days in the past week a person felt hopeful about the future.

The wave of the survey was significantly associated with changes in alcohol consumption. Specifically, individuals who participated in Waves 5 (18 to 22 September), 6 (27 November to 1 December) and 7 (19 to 23 March 2021) were more likely to report a lower category of change in alcohol use than were people who participated in Wave 2 (29 May to 1 June 2020).

In models performed for men and women separately (see Tables 3 and 4), age, income, the number of days a respondent felt depressed or lonely and survey wave were significantly associated with changes in alcohol consumption for both men and women. Living situation was significantly associated with changes in alcohol consumption for men but not for women. Furthermore, anxiety was significantly associated with changes in alcohol consumption for women but not for men.

Despite differences in the significance of ordered ORs for independent variables when modelling data stratified by gender, the assessment through likelihood ratio tests for interactions of gender with age, household income, a person's living situation, household income, changes in employment, residence location, anxiety and the number of days feeling depressed or lonely in the past week in

association with changes in alcohol consumption showed that such interactions were not statistically significant (see Table S9 in the supplemental material).

The VIF for the statistical models based on men, women and the total sample indicated that multicollinearity was not a problem (see Table S10 in the supplemental material). Sensitivity analyses indicated that models which included demographic variables and survey wave did not appreciably differ from the full model when variables were added for anxiety, or number of days feeling depressed or number of days feeling lonely. However, when variables for anxiety, depression and loneliness were excluded from the model, the variable for the number of days feeling hopeful about the future became a significant predictor of changes in alcohol use during the COVID-19 pandemic.

DISCUSSION

The present study indicated that changes in alcohol consumption were significantly associated with anxiety, feeling depressed and loneliness; people who had higher levels of anxiety and more frequent feelings of depression and loneliness were most likely to increase their alcohol consumption. Furthermore, changes in alcohol consumption were significantly associated with gender, age, household income, a person's living situation and survey wave. Changes in alcohol consumption were not significantly associated with changes

Table 2. Alcohol consumption, anxiety and depression measures of the web panel sample, by gender

		Total		Men		Women	
		Prevalence (%)	(95% CI)	Prevalence (%)	(95% CI)	Prevalence (%)	(95% CI)
Drinking status	Drinker	59.1	(57.9, 60.4)	63.9	(62.1, 65.6)	54.5	(52.7, 56.4)
	Abstainer	40.9	(39.6, 42.1)	36.1	(34.4, 37.9)	45.5	(43.6, 47.3)
Changes in drinking	Drank much less alcohol	6.9	(6.3, 7.6)	6.7	(5.8, 7.7)	7.2	(6.2, 8.1)
	Drank slightly less alcohol	6.4	(5.8, 7.1)	7.0	(6.1, 8.0)	5.9	(5.0, 6.8)
	No change	66.0	(64.8, 67.2)	64.8	(63.0, 66.5)	67.3	(65.5, 69.0)
	Drank slightly more alcohol	16.4	(15.5, 17.4)	16.6	(15.3, 18.0)	16.2	(14.9, 17.6)
	Drank much more alcohol	4.3	(3.8, 4.8)	4.9	(4.1, 5.7)	3.5	(2.9, 4.3)
Anxiety (GAD-7 score)	Low (0 to 4)	51.6	(50.3, 52.9)	56.6	(54.8, 58.5)	46.9	(45.0, 48.7)
	Mild to moderate (5 to 14)	39.2	(38.0, 40.5)	36.0	(34.3, 37.8)	42.4	(40.6, 44.2)
	Severe (15 or greater)	9.1	(8.4, 9.9)	7.4	(6.4, 8.4)	10.8	(9.7, 12.0)
Number of days feeling depressed	None	53.6	(52.3, 54.9)	58.2	(56.4, 60.0)	49.4	(47.5, 51.2)
	1 to 2	26.2	(25.1, 27.3)	24.2	(22.7, 25.8)	28.0	(26.4, 29.7)
	3 to 4	13.4	(12.6, 14.3)	12.3	(11.1, 13.5)	14.5	(13.2, 15.8)
	5 to 7	6.8	(6.1, 7.4)	5.3	(4.5, 6.1)	8.1	(7.1, 9.1)
Number of days feeling lonely	None	51.9	(50.6, 53.2)	57.3	(55.4, 59.1)	46.7	(44.9, 48.6)
	1 to 2	26.0	(24.9, 27.1)	23.3	(21.7, 24.8)	28.8	(27.1, 30.4)
	3 to 4	13.7	(12.8, 14.6)	12.7	(11.6, 14.0)	14.6	(13.3, 15.9)
	5 to 7	8.4	(7.7, 9.2)	6.7	(5.8, 7.7)	9.9	(8.9, 11.0)
Number of days feeling hopeful about the future	None	21.0	(20.0, 22.1)	21.2	(19.7, 22.7)	20.9	(19.4, 22.4)
	1 to 2	30.5	(29.4, 31.7)	28.2	(26.5, 29.8)	32.8	(31.1, 34.6)
	3 to 4	30.4	(29.2, 31.6)	32.1	(30.4, 33.9)	28.6	(26.9, 30.2)
	5 to 7	18.1	(17.1, 19.1)	18.5	(17.1, 20.0)	17.7	(16.4, 19.2)
	2 (29 May to 1 June 2020)	16.8	(15.8, 17.7)	16.6	(15.3, 18.0)	16.7	(15.4, 18.1)
	3 (19 to 23 June 2020)	16.7	(15.7, 17.6)	16.8	(15.5, 18.2)	16.6	(15.3, 18.0)
	4 (10 to 14 July 2020)	16.7	(15.7, 17.7)	16.9	(15.5, 18.3)	16.4	(15.1, 17.8)
5 (18 to 22 September 2020)	16.6	(15.7, 17.6)	16.6	(15.3, 18.0)	16.6	(15.3, 18.0)	
6 (27 November to 1 December 2020)	16.7	(15.7, 17.6)	16.4	(15.1, 17.8)	17.0	(15.6, 18.4)	
7 (19 to 23 March 2021)	16.6	(15.7, 17.6)	16.7	(15.3, 18.1)	16.6	(15.3, 18.0)	

in employment status, location of residence (urban, suburban or rural) or the number of days in the past week a person felt hopeful about the future.

The COVID-19 pandemic and social distancing measures have been associated with increases in anxiety and depression (Shevlin et al. 2020; Wang et al. 2020). The exact reasons for increases in alcohol consumption during the COVID-19 pandemic are unknown; however, the present cross-sectional study suggests that increases in anxiety, feelings of depression and/or loneliness may lead to increases in alcohol consumption. Further, this relationship may be bidirectional, with increased alcohol consumption also increasing anxiety and/or feelings of depression (Rehm et al. 2017).

Household income was significantly associated with changes in alcohol consumption. This may be explained, in part, by the fact that people in higher socio-economic status groups are less sensitive to environmental changes (e.g. price changes and financial strains (Holmes et al. 2014) compared to people in lower socio-economic status groups.

The observed changes in alcohol consumption differed for people of different ages. In particular, alcohol consumption increased among people 30 years of age and older compared to people 18 to 29 years of age. This may be due to the differing contexts of alcohol consumption by age, and to the closing of on-premise drinking establishments during the pandemic. Indeed, people of younger ages are more likely

Table 3. Adjusted Ordered Odds Ratios for changes in alcohol consumption, by demographic measures

Independent variable		Total			Men			Women		
		Ordered OR*	(95% CI)	P value	Ordered OR*	(95% CI)	P value	Ordered OR*	(95% CI)	P value
Gender	Male	1.10	(0.99, 1.23)	0.08						
	Female	REF	-	-						
	Other	1.86	(1.01, 3.41)	0.05						
Age (years)	18 to 29	REF	-	-	REF	-	-	REF	-	-
	30 to 39	1.31	(1.08, 1.58)	<0.01	1.17	(0.88, 1.55)	0.28	1.43	(1.11, 1.86)	<0.01
	40 to 49	1.86	(1.51, 2.30)	<0.01	1.79	(1.31, 2.45)	<0.01	1.86	(1.38, 2.49)	<0.01
	50 to 59	1.37	(1.11, 1.68)	<0.01	1.26	(0.93, 1.71)	0.14	1.44	(1.08, 1.91)	0.01
	60 to 69	1.42	(1.15, 1.76)	<0.01	1.28	(0.93, 1.77)	0.13	1.53	(1.15, 2.05)	<0.01
	70 and older	1.29	(1.01, 1.65)	0.04	1.22	(0.85, 1.74)	0.28	1.25	(0.88, 1.76)	0.21
Living situation	Live alone	REF	-	-	REF	-	-	REF	-	-
	Live with someone else	1.19	(1.03, 1.37)	0.02	1.37	(1.11, 1.67)	<0.01	1.02	(0.83, 1.24)	0.86
Household income (per year)	<\$40,000	REF	-	-	REF	-	-	REF	-	-
	40,000 to 79,000	1.12	(0.93, 1.36)	0.23	1.01	(0.77, 1.34)	0.93	1.27	(0.97, 1.66)	0.08
	\$80,000 to \$119,000	1.37	(1.12, 1.67)	<0.01	1.26	(0.95, 1.68)	0.11	1.50	(1.13, 1.98)	<0.01
	\$120,000 and over	1.57	(1.28, 1.93)	<0.01	1.40	(1.05, 1.88)	0.02	1.78	(1.33, 2.37)	<0.01
	Prefer not to answer	1.13	(0.92, 1.39)	0.25	1.09	(0.79, 1.51)	0.60	1.20	(0.91, 1.59)	0.21
Changes in employment status	No change	REF	-	-	REF	-	-	REF	-	-
	Newly employed	1.10	(0.82, 1.49)	0.53	0.85	(0.55, 1.33)	0.49	1.33	(0.87, 2.02)	0.18
	Unemployed	1.22	(0.96, 1.57)	0.11	1.22	(0.87, 1.71)	0.25	1.13	(0.79, 1.63)	0.50
	Student / retired	0.98	(0.79, 1.22)	0.86	0.87	(0.64, 1.19)	0.39	1.12	(0.83, 1.52)	0.46
	Working from home	1.19	(0.97, 1.45)	0.09	1.06	(0.80, 1.40)	0.68	1.32	(0.98, 1.77)	0.07
	Other	1.03	(0.85, 1.26)	0.74	0.88	(0.67, 1.16)	0.38	1.21	(0.90, 1.62)	0.21
Residence	Rural	REF	-	-	REF	-	-	REF	-	-
	Suburban	0.98	(0.84, 1.15)	0.81	1.00	(0.78, 1.27)	0.97	0.99	(0.80, 1.22)	0.90
	Urban	0.94	(0.81, 1.10)	0.44	1.04	(0.82, 1.32)	0.74	0.87	(0.70, 1.07)	0.19

OR: Odds Ratio

*Ordinal categorization of changes in alcohol consumption (lowest to highest): drank 'much less alcohol', drank 'slightly less alcohol', experienced 'no change' in alcohol consumption, drank 'slightly more alcohol', or drank 'much more alcohol' compared to before the start of the COVID-19 pandemic

*All models included measures of anxiety and depression (see Table 4).

to consume alcohol on premise, whereas people who are older in age are more likely to consume alcohol off premise (Treno et al. 2000). Thus, the latter group may have been more likely to increase their drinking due to their general propensity to drink at home.

The findings of this study should be viewed within the context of its limitations, particularly with respect to its representativity. Firstly, the surveys were performed in English only, and therefore the quota sampling was designed to be representative of English-speaking or bilingual Canadians. As a result, the effects of the COVID-19 pandemic on alcohol consumption during the studied time period may be underestimated as Quebec has experienced the highest COVID-19 mortality rates in Canada (Government of Canada 2020). Secondly, the AskingCanadians web panel had a response rate of 15.7% (see Table S1 in the supplemental material). Although quota sampling was used to achieve an age-, sex- and regionally representative sample, participation bias may have been introduced since people who are more likely to participate in surveys typically consume less alcohol (Shield and Rehm 2012); however, it is currently unclear whether participation bias affects the measurement of changes in alcohol consumption. Furthermore, the low response rate should not notably bias the measurement of the relationship between changes in alcohol consumption and demographics, anxiety and depression as response rates do not affect the measurement of associations (Groves 2004)

(with the exception of effect modification where the association of interest differs in magnitude or direction across subgroups which are less likely to participate or be surveyed).

The measurement of depression, loneliness and hopefulness are limited as they are based on self-perception and therefore subjective. Although correlated, anxiety, depression, loneliness and hopefulness did not present multicollinearity problems for the ordinal logistic regression model. Furthermore, the finding that hopefulness was a significant predictor of change in alcohol use during the COVID-19 pandemic (when only demographic and survey wave variables were included in the model) is likely the result of confounding due to anxiety, depression and loneliness not being taken into account.

The measurement of changes in alcohol consumption are limited by several factors. Firstly, this measurement is retrospective and cross-sectional, and therefore it is susceptible to recall bias (Groves 2004). Secondly, the measurement of changes in alcohol consumption is based on self-reporting, and thus is subjective. Therefore, small changes in alcohol consumption may be indicated as no change; however, small changes in alcohol consumption at the individual level may have a large impact on public health (Groves 2004). Furthermore, reporting of changes in alcohol consumption may be susceptible to response bias where the respondent deliberately misreports changes in consumption to conform to social norms (Randall and Fernandes

Table 4. Adjusted Ordered Odds Ratios for changes in alcohol consumption, stratified by measures of anxiety, depression, loneliness, hopefulness and survey wave

Independent variable		Total			Men			Women		
		Ordered OR*	(95% CI)	P value	Ordered OR*	(95% CI)	P value	Ordered OR*	(95% CI)	P value
Anxiety (GAD-7 score)	Low (0 to 4)	REF	-	-	REF	-	-	REF	-	-
	Mild to moderate (5 to 14)	1.23	(1.07, 1.42)	<0.01	1.16	(0.94, 1.42)	0.16	1.30	(1.07, 1.59)	<0.01
	Severe (15 or greater)	1.49	(1.15, 1.93)	<0.01	1.48	(1.00, 2.19)	0.05	1.54	(1.09, 2.18)	0.01
Number of days feeling depressed	None	REF	-	-	REF	-	-	REF	-	-
	1 to 2	1.36	(1.17, 1.58)	<0.01	1.43	(1.15, 1.78)	<0.01	1.29	(1.05, 1.59)	0.02
	3 to 4	1.48	(1.20, 1.83)	<0.01	1.42	(1.03, 1.94)	0.03	1.52	(1.14, 2.03)	<0.01
	5 to 7	1.42	(1.04, 1.94)	0.03	1.89	(1.16, 3.06)	<0.01	1.06	(0.70, 1.61)	0.78
Number of days feeling lonely	None	REF	-	-	REF	-	-	REF	-	-
	1 to 2	1.07	(0.93, 1.23)	0.32	1.16	(0.95, 1.42)	0.15	1.01	(0.83, 1.23)	0.89
	3 to 4	1.24	(1.02, 1.50)	0.03	1.35	(1.02, 1.80)	0.04	1.14	(0.87, 1.49)	0.34
	5 to 7	1.51	(1.16, 1.96)	<0.01	1.37	(0.92, 2.06)	0.13	1.51	(1.06, 2.15)	0.02
Number of days feeling hopeful about the future	None	0.85	(0.71, 1.01)	0.06	0.84	(0.66, 1.06)	0.15	0.90	(0.70, 1.16)	0.40
	1 to 2	0.96	(0.81, 1.13)	0.63	0.89	(0.70, 1.12)	0.32	1.09	(0.86, 1.38)	0.49
	3 to 4	0.91	(0.78, 1.07)	0.26	0.89	(0.71, 1.11)	0.30	0.95	(0.75, 1.21)	0.69
	5 to 7	REF	-	-	REF	-	-	REF	-	-
Wave	2 (29 May to 1 June 2020)	REF	-	-	REF	-	-	REF	-	-
	3 (19 to 23 June 2020)	0.96	(0.80, 1.15)	0.65	0.86	(0.67, 1.12)	0.26	1.09	(0.84, 1.42)	0.52
	4 (10 to 14 July 2020)	0.93	(0.77, 1.11)	0.42	0.88	(0.68, 1.13)	0.31	0.99	(0.76, 1.29)	0.94
	5 (18 to 22 September 2020)	0.74	(0.62, 0.89)	<0.01	0.67	(0.52, 0.87)	<0.01	0.81	(0.63, 1.06)	0.13
	6 (27 November to 1 December 2020)	0.77	(0.64, 0.93)	<0.01	0.71	(0.54, 0.92)	<0.01	0.86	(0.66, 1.12)	0.26
	7 (19 to 23 March 2021)	0.69	(0.57, 0.83)	<0.01	0.72	(0.55, 0.94)	0.01	0.65	(0.50, 0.85)	<0.01

OR: Odds Ratio

*Ordinal categorization of changes in alcohol consumption (lowest to highest): drank 'much less alcohol', drank 'slightly less alcohol', experienced 'no change' in alcohol consumption, drank 'slightly more alcohol', or drank 'much more alcohol' compared to before the start of the COVID-19 pandemic

*All models included demographics measures (see Table 3)

1991); this form of bias has been observed previously for highly stigmatized behaviours, such as alcohol use and mental health problems (Randall and Fernandes 1991; Johnson et al. 1999; Shield and Rehm 2012). Lastly, the measurement of changes in alcohol consumption is with respect to overall consumption, and therefore the findings of this study may not apply to changes in drinking status, the frequency of alcohol consumption, the volume of alcohol consumed during drinking occasions and engaging in heavy episodic drinking.

CONCLUSIONS

This study's findings suggest that changes in alcohol consumption since the start of the COVID-19 pandemic are associated with anxiety, feeling depressed and/or loneliness. In particular, increases in anxiety and depression due to the pandemic may have contributed to increases in alcohol consumption; however, the potential for reverse causality was not accounted for in this study.

Although it is currently unknown if changes in alcohol consumption during the pandemic will persist after the pandemic, increased alcohol consumption during the pandemic will have immediate negative health effects on the burden of infectious diseases, non-communicable diseases and injuries in Canada. It will be important to continue monitoring alcohol consumption as physical distancing restrictions are eased, as well as the long-term effects of the pandemic on drinking patterns and associated health outcomes. However, in the short-term, public health policies and primary care physicians should offer support to people whose alcohol consumption has increased, and in particular to those people with increased anxiety and depression.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Alcohol and Alcoholism* online.

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DECLARATIONS OF COMPETING INTERESTS

None declared.

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