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Is talk cheap? Correspondence between self-attributions about changes in drinking and longitudinal changes in drinking during the 2019 coronavirus pandemic

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Abstract

Background: There are concerns that the coronavirus disease 2019 (COVID-19) pandemic may increase drinking, but most accounts to date are cross-sectional studies of self-attributions about alcohol-related impacts and the accuracy of those perceptions has not been investigated. The current study examined the correspondence between self-attributions of pandemic-related changes in drinking and longitudinally-measured changes in drinking and alcohol-related consequences in a sample of emerging adults.

Methods: In an existing ongoing longitudinal study on alcohol misuse (≥1 heavy episodic drinking day/month) in emerging adults, 473 individuals (M_{age} = 23.8; 41.7% male) received a supplemental assessment from June 17th to July 1st, 2020, during public health restrictions in Ontario, Canada. These intrapandemic data were matched to the most recent assessment prior to the pandemic (~8 months earlier). Self-attributions about changes in drinking were assessed globally (i.e., increases/decreases/no change) and with higher resolution questions clarifying the magnitude of changes.

Results: Global self-attributions about changes in drinking substantively paralleled longitudinal changes in weekly drinking days (DD). In the longitudinal data, individuals' who self-reported increases in drinking exhibited significant increases; individuals' who self-reported decreases exhibited significant decreases; and individuals who self-reported no change exhibited nonsignificant changes. Higher resolution items likewise revealed longitudinal patterns of weekly drinking that were substantively consistent with self-attributions. Heavy DD and alcohol-related consequences exhibited similar patterns, but only individuals who self-reported large increases in drinking exhibited increases on these outcomes. Individuals who reported large increases in drinking also exhibited significant increases in depression and posttraumatic stress disorder symptoms.

Conclusions: Self-attributions about drinking closely corresponded to longitudinal changes in drinking, supporting the validity of self-attributions in population-level surveys, particularly in young adults. Notably, a subgroup was identified that exhibited pronounced increases for all alcohol-related outcomes and concurrent increases in internalizing psychopathology.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has generated a public health crisis across the world. To slow transmission, governments have enacted stay-at-home orders and public health interventions, such as physical distancing and self-isolation. Although these interventions have controlled the spread of the virus, they have raised concerns about potential increases in mental health problems and substance use (Clay & Parker, 2020; Frasquilho et al., 2016).

With regard to drinking, a number of large-scale self-report surveys have been conducted. Kilian et al. (2021) conducted a survey of ~32,000 individuals in 21 European countries and found a small decrease in alcohol consumption in all nations other than Ireland and the United Kingdom. In Norway, a survey of ~16,000 adults found a small increase overall, but most individuals decreased use while the upper 5–10% of frequent users exhibited an increase (Rossow et al., 2021). In Canada, the Canadian Centre on Substance use and Addiction (2020) found that 70% of Canadians who reported an increase in time spent at home due to COVID-19 reported their alcohol consumption stayed the same, while 18% reported increases (CCSA, 2020). Similarly, in a population-level survey, Statistics Canada found that 24% of respondents were drinking more alcohol compared to before the pandemic (Statistics Canada, 2021a), while 24% reported drinking less and 54% reported no change (Statistics Canada, 2021a). Thus, large increases in drinking have fortunately not been observed at the population level in general, although there appear to be notable increases in some subgroups, such as in individuals with substance use disorders (Gili et al., 2021) and individuals with increased psychiatric severity (Tran et al., 2020).

Although rapid estimates of drinking changes during the pandemic are a credit to the field, a methodological concern is that the data to date are primarily self-attributions about changes in alcohol use; that is, pandemic-related changes in drinking are typically measured by questions about perceptions of changes, sometimes using very coarse distinctions (e.g., no change, increased drinking, decreased drinking; Reynolds et al., 2021) and sometimes including higher resolution estimates of the extent of the percentage changes (Rossow et al., 2021). In either case, there has been long-standing concern in alcohol research with respect to the extent to which self-attributions are accurate and valid (Del Boca & Darkes, 2003).

The current study addresses this question using data from a recent longitudinal study of drinking during the pandemic in emerging adults (Minhas et al., 2021). In that study, a supplemental COVID-19 assessment was administered in an ongoing longitudinal observational cohort design, permitting comparisons of prepandemic drinking and intrapandemic drinking. This took place during the early phase of the pandemic, when significant public health restrictions were in place in Ontario. Previously, we reported significant decreases in the number of heavy drinking days (HDD) and alcohol-related problems, albeit with considerable heterogeneity in the direction and magnitude of these changes (Minhas et al., 2021). Critically, self-attributions about pandemic-related changes in drinking were also assessed in that study, including whether a person changed and more specific estimates of by how much. Therefore, to inform the validity of self-attributions about alcohol use during the pandemic, the current study examined correspondence between the longitudinal changes in drinking (as assessed by validated measures) and participant self-attributions. As a secondary analysis, the study also examined changes in mental health outcomes (i.e., measures of depression, anxiety, and posttraumatic stress disorder [PTSD]) based on changes in self-perceived drinking. As increases in drinking have been associated with increased psychiatric severity (Tran et al., 2020), this was also predicted in the current study, albeit without greater specificity in terms of level of increase or type of psychopathology.

METHODS

Study design

The impact of COVID-19 pandemic was assessed in individuals from an ongoing longitudinal study on alcohol misuse in emerging adults. The original cohort of individuals ($N = 730$) was recruited in Hamilton, Ontario, in 2017. The intra-COVID assessment was administered June 17th to July 1st, 2020, during COVID-19 lockdown. These intra-COVID data were compared to the most recent assessment prior to the declaration of the pandemic status of COVID-19 by the World Health Organization and following declaration of a state of an emergency in Ontario on March 17th, 2020 (pre-COVID). See Minhas et al. (2021) for a more detailed study description. The current analysis examined changes between the time period prior to the onset of the pandemic and during the acute phase of public health restrictions in order to characterize the impact of COVID-19 pandemic on alcohol use and mental health.

Participants

Participants were a community sample of emerging adults recruited from the general population in Hamilton, Ontario. Participants were recruited using newspaper, bus, and online ads. The eligibility criteria for participation in the original cohort study included heavy episodic drinking (HED; >4/3 standard drinks for males/females; Butt et al., 2011) on at least two days in the past month or at least one HED episode and one cannabis use episode per month; age 19.5–23 years

old; fluency in written English; and no current or past psychosis (i.e., schizoaffective disorder, schizophrenia, or similar conditions). Participants were generally representative of a nontreatment seeking heavy drinking subgroup within this age range. Of the original sample (n = 730), 708 individuals were still enrolled in the study and offered the supplemental COVID assessment. Of these participants, 518 accepted the invitation to participate in the supplemental survey (73% response rate). Individuals were then excluded if they did not have a recent pre-COVID assessment or provided data suggesting low effort or attention (see Minhas et al., 2021). The final sample size for this analysis was n = 473 (58.4% female, 70.4% White race), median income (pre-COVID) = $45,000 to <$60,000, median education (pre-COVID) = Associates/Bachelors. As previously reported, participants average age was 23.4 years at the prepandemic assessment and 23.8 years at the intrapandemic assessment (Minhas et al., 2021). Additional sample characteristics, Strengthening the Reporting of Observational Studies in Epidemiology participant flowchart and study design are reported in Minhas et al. (2021). There were no differences between participants' that were included and excluded from the assessment in terms of ethnicity, age, and HDD/week. There were clinically small differences in drinking days (DD) per week (included: 2.45 ± 1.73, excluded: 2.06 ± 1.62, p = 0.04). All assessments were conducted using Research Electronic Data Capture software (Harris et al., 2019), and all aspects of study procedures were reviewed and approved by the Hamilton Research Ethics Board (Protocol #2193). Participants provided electronic informed consent, followed by the assessments. Participants received a gift card ($30 CAD) for completing each assessment.

Assessments

To assess perceived changes (self-attributions) in drinking, individuals were asked "Has the COVID-19 pandemic affected your alcohol use in any way?" Participants chose between, "Yes, my use has increased," "Yes, my use has decreased," or "No, my use has not changed." If participants stated a change in alcohol use, they were asked "Approximately how much has your alcohol use increased/decreased as a result of COVID-19?" Participants chose between: "A small amount (e.g., 10% increase)," "A moderate amount (e.g., 30% increase)," "A large amount (e.g., 60% increase)," or "A very large amount (e.g., 100% increase/doubled your drinking or more)."

The Daily Drinking Questionnaire measures the quantity and frequency of an individual's weekly alcohol consumption (Collins et al., 1985). Participants were asked to estimate the typical number of daily standard drinks consumed on each day of the week (Monday–Sunday) over the last month. This was used to calculate average number of drinking days (DD) per week and average number of HDD per week. HDD were defined as days on which more than three drinks for females and more than four drinks for men were consumed (Centre on Substance Use, 2019; NIAAA, 2017). Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler et al., 2008) measures consequences from drinking. It is comprised of 24 self-reported items that are scored dichotomously (yes/no) about a range of harmful drinking consequences experienced in a given time frame (i.e., past 4 months for pre-COVID survey and during the COVID public health lockdown implemented between March 14th, 2020–May 31st, 2020, for the intra-COVID survey) by emerging adults. A total score on the B-YAACQ ranges from 0 to 24, with higher scores indicating greater alcohol associated problems.

For self-reported mental health indicators, the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2010) was used to evaluate clinical symptoms of depression; the Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006) was used to evaluate clinical symptoms of anxiety; and the PTSD checklist-5 (PCL-5; Blevins et al., 2015) was used to evaluate symptoms associated with PTSD. Scores of ≥10 on the GAD-7, ≥10 on the PHQ-9, and ≥33 on the PCL-5 were used to indicate clinically significant levels of anxiety, depression, and PTSD, respectively (Blevins et al., 2015; Löwe et al., 2004; Manea et al., 2012). Furthermore, a 5-point change was considered clinically significant change on PHQ-9 and PCL-5 (Blevins et al., 2015; Löwe et al., 2004), whereas a 4-point change was used for the GAD-7 (Toussaint et al., 2020).

Data analysis

The primary aim was to investigate the correspondence between self-attributions of pandemic-related changes in drinking and actual changes from prepandemic to intrapandemic. To maximize power/reliability and be consistent with surveys using trichotomous options (increase, decrease, no change), individuals were first categorized into one of three meaningful groups with respect to perceived changes in alcohol use: increase (10–100%+), decrease (10–100%), or no changes in alcohol use. To provide greater resolution of the findings and map on to studies using higher resolution self-attributions, individuals were categorized into one of five groups with respect to perceived changes: small increase (i.e., 10–30%), large increase (i.e., 60–100%+), small decrease (i.e., 10–30%), large decrease (i.e., 60–100%), or no change in alcohol use. Finer gradations were not used because of very small cell sizes. A secondary aim investigated whether there was a correspondence between self-attributions of pandemic-related changes in drinking (at the 5-level) and mental health. Linear mixed effects models (LMMs) were used to analyze the self-perceived and actual changes in alcohol-related behavior from the pre- to intra-COVID time period. These LMMs were fit by restricted maximum likelihood to produce unbiased model estimates and modeled using the "lme4" package (Bates et al., 2015), and the significance of the main and interaction fixed effects was tested using type II analysis-of-variance tables from the "car" package (Fox & Weisberg, 2019). For significant interaction effects between time and subjective change, post hoc tests were conducted to determine which groups saw significant changes in mean response from the pre- to intra-COVID time period. These post hoc tests were carried out using the "emmeans" package (Lenth, 2020). Lastly, proportionate changes in drinking-related variables were calculated as the overall

subgroup change (i.e., [mean pre-COVID – mean intra-COVID]/mean pre-COVID). All analyses were conducted using R version 4.0.3 (R Core Team, 2020). To adjust for multiple comparisons, a Bonferroni correction was used, and the significance level was set at α ≤ 0.003.

RESULTS

Self-attributions about COVID-related drinking

Self-perceived pandemic-related changes in drinking behavior are reported in Table 1. Approximately 30% of the sample (ns = 144) reported that their alcohol use increased and ~31% of the sample (ns = 146) reported that their alcohol use decreased. The remaining participants (ns = 183) reported that their alcohol use did not change. Descriptive statistics for the 5-level self-attribution groups can be found in Table S1.

Longitudinal changes in drinking and global (3-level) self-attributions

The following analyses assessed self-attributional changes (Subjective Change) in alcohol consumption and objective measures of alcohol use and alcohol-related problems pre- to intra-COVID (Table 2; Figure 1), largely confirming self-attributions to be accurate. For DD, LMMs revealed a significant main effect of Subjective Change, as well as a significant Time ×Subjective Change interaction. Post hoc tests revealed a significant 1.47 increase of DD per week for those that perceived an increase in their drinking since the start of COVID-19. Those perceiving a decrease reported a significant decrease of 1.12 DD per week. No significant changes were found for those perceiving no changes in their drinking.

For HDD, LMMs revealed a significant main effect of Time and Subjective Change, as well as a significant Time × Subjective Change interaction. Post hoc tests revealed a significant increase of 0.26 HDD for those perceiving increases in their drinking and a significant decrease of 0.62 HDD for those self-reporting perceived decreases in their drinking. No significant changes were found for those self-reporting no changes in their drinking.

For alcohol consequences, LMMs revealed a significant main effect of Time and Subjective Change, as well as a significant Time × Subjective Change interaction. Post hoc tests revealed no significant changes in the number of alcohol-related problems for those perceiving increases in their drinking, but alcohol consequences significantly decreased, on average, by 1.31 and 2.73 for those perceiving no change or a decrease in their drinking.

Longitudinal changes in drinking and high-resolution (5-level) self-attributions

Self-attributional changes (Subjective Change) in alcohol consumption as a function of five levels and objective measures of alcohol use and alcohol-related problems pre- to intra-COVID are in Tables 3 and 4 and Figure 2. With regard to DD, LMMs revealed a significant main effect of Subjective Change, as well as a significant Time × Subjective Change interaction. Post hoc tests revealed a significant 1.26 (or 40.9%) and 2.33 (or 73.0%) increase in DD per week for those that perceived small and large increases, respectively, in their drinking since the start of COVID-19. Those perceiving a small or large decrease reported a significant decrease of 0.64 (or 24.2%) and 1.45 (or 61.2%) in DD per week, respectively. No significant changes were found for those perceiving no changes in drinking.

With regard to HDD, LMMs revealed a significant main effect of Time, Subjective Change, and Time × Subjective Change interaction. Post hoc tests revealed a significant 1.26 (or 161.5%) increase in HDD per week for those that perceived a large increase in their drinking since the start of COVID-19. Those perceiving a small or large decrease reported a significant decrease of 0.67 (or 72.8%) and 0.58 (92.1%) HDD per week, respectively. No significant changes were found for those perceiving no changes or small increase in drinking.

With regard to B-YAACQ scores, LMMs revealed a significant main effect of Time, Subjective Change, and Time × Subjective Change interaction. Post hoc tests revealed a significant increase of 2.08 (or 37.2%) in B-YAACQ for those that perceived a large increase in their drinking since the start of COVID-19. Those perceiving a small increase in drinking reported a significant decrease of 0.69 (or 17%). Those perceiving a small or large decrease reported a

TABLE 1 Raw responses on the assessment of self-attributions of changes in drinking

Change	Response	ns	%
Decrease (30.86%)	A very large amount (e.g., 100% decrease/eliminated drinking)	44	9.30
	A large amount (e.g., 60% decrease)	43	9.09
	A moderate amount (e.g., 30% decrease)	40	8.46
	A small amount (e.g., 10% decrease)	19	4.02
No change (38.69%)		183	38.69
Increase (30.44%)	A small amount (e.g., 10% increase)	58	12.26
	A moderate amount (e.g., 30% increase)	59	12.47
	A large amount (e.g., 60% increase)	17	3.59
	A very large amount (e.g., 100% increase/doubled drinking)	10	2.11

TABLE 2 Longitudinal changes in quantitative indicators of alcohol consumption and alcohol problems as a function of cross-sectional trichotomized subjective attributions of pandemic-induced changes (i.e., increased, decreased, did not change)

	Time		Subjective change		Time × subjective change	
	F	p	F	p	F	p
DD per Week	0.86	0.36	81.31	**<2e−16**	86.03	**<2e−16**
HDD per week	7.06	**8.17e−04**	23.43	**1.99e−10**	21.98	**7.51e−10**
B-YAACQ	73.08	**<2.2e−16**	32.99	**3.93e−14**	18.86	**1.32e−08**

Notes: Significant effects are in boldface.

Abbreviations: B-YAACQ, Brief Young Adult Alcohol Consequences Questionnaire; DD, drinking days; HDD, heavy drinking days.
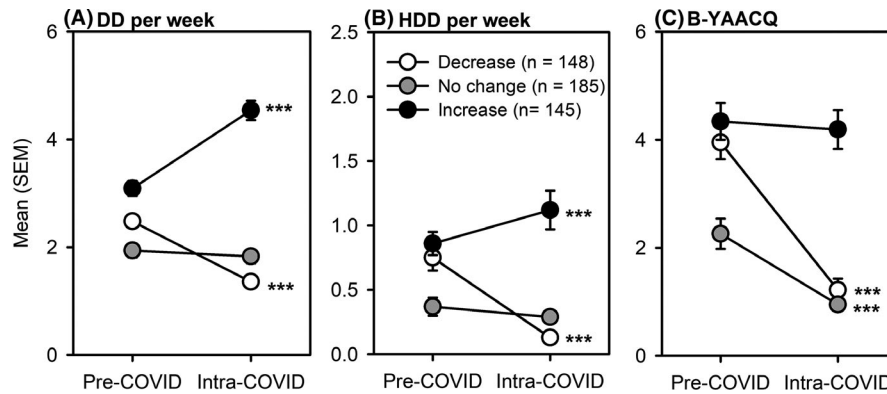

FIGURE 1 Longitudinal differences in drinking days (DD) per week (Panel A), heavy drinking days (HDD) per week (Panel B), and alcohol consequences (B-YAACQ; Panel C) as a function of trichotomized self-attributions about changes in drinking behavior (i.e., increased, decreased, or stayed the same). Notation: $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

TABLE 3 Longitudinal changes in quantitative indicators of alcohol consumption and alcohol problems as a function of 5-level cross-sectional subjective attributions of pandemic-induced changes (i.e., large increase, small increase, no change, small decrease, large decrease)

	Time		Subjective change		Time × subjective change	
	F	p	F	p	F	p
DD per week	0.88	0.35	44.21	**<2e−16**	48.72	**<2e−16**
HDD per week	7.43	**6.0E−03**	14.29	**5.12e−11**	18.24	**6.11e−14**
B-YAACQ	75.09	**<2.2e−16**	23.14	**<2.2e−16**	13.41	**2.37e−10**

Note: Significant effects are in boldface.

B-YAACQ, Brief Young Adult Alcohol Consequences Questionnaire; HDD, heavy episodic drinking.

significant decrease in B-YAACQ of 2.32 (or 56.9%) and 3 (or 77.9%), respectively. Those perceiving no change in drinking reported a significant decrease of 1.31 (or 58%) in B-YAACQ.

Cross-sectional drinking self-attributions and longitudinal changes in mental health outcomes

Self-attributions of changes (Subjective Change) in alcohol consumption and mental health problems pre- to intra-COVID are in Table 5 and Figure 3. For depression, LMMs revealed a significant main effect of Time, as well as a significant Time × Subjective Change interaction. Post hoc tests revealed a significant 1.29 and 2.71 increase in PHQ-9 scores for those that perceived small

and large increases, respectively, in their drinking since the start of COVID-19. Those perceiving no changes in drinking reported a significant 0.67 increase in PHQ-9 scores. Those perceiving a small or large decrease in drinking reported no changes in mental health. For anxiety, LMMs revealed a significant main effect of Time. Comparisons of marginal means revealed that there was a significant increase in anxiety over the course of the COVID-19 pandemic.

For PTSD, LMMs revealed a significant main effect of Subjective Change, as well as a Time × Subjective Change interaction. Post hoc tests revealed a significant ~10-point increase in PCL-5 scores for participants who perceived large increases in their drinking since the start of COVID-19. There were no changes in PCL-5 scores for those perceiving small increases, no change, small decreases, or large decreases.

TABLE 4 Proportionate changes in longitudinal levels of DD/week, HDD/week, and alcohol consequences (B-YAACQ)

	DD per week (%)	HDD per week (%)	B-YAACQ (%)
Panel A			
Decrease	−45.2	−82.6	−69.1
No change	−3.7	−21.6	−58.0
Increase	+47.15	+30.2	−3.7
Panel B			
Large decrease (e.g., 60–100%)	−61.2	−92.1	−77.9
Small decrease (e.g., 10–30%)	−24.2	−72.8	−56.9
No change	−3.7	−21.6	−58.0
Small increase (e.g., 10–30%)	+40.9	+3.4	−17.0
Large increase (e.g., 60–100%+)	+73.0	+161.5	+37.2

Note: Green reflects reduction of 10% or more; yellow reflects decreases or increases of <|10%|; and red reflects increases of 10% or more.
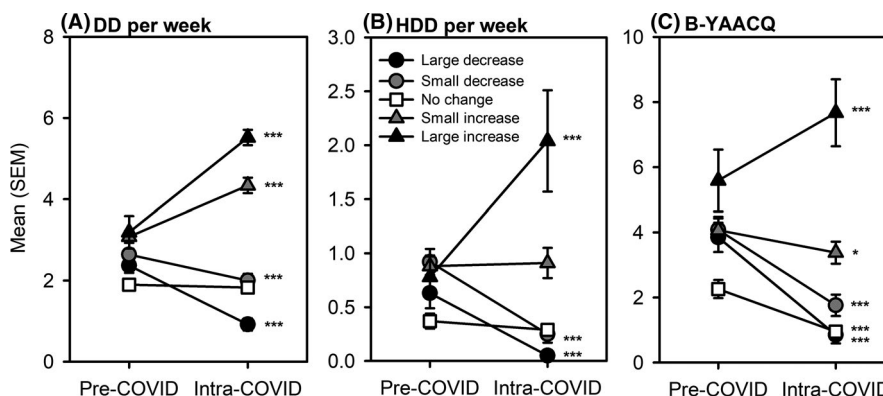B-YAACQ, Brief Young Adult Alcohol Consequences Questionnaire; DD, drinking days; HDD, heavy drinking days.

FIGURE 2 Longitudinal differences in DD per week (Panel A), HDD per week (Panel B), and alcohol consequences (B-YAACQ; Panel C) as a function of five levels of self-attributions about changes in drinking (i.e., large decrease = ~60–100%; small decrease = ~10–30%; no change; small increase = ~10–30%; large increase = ~60–100+% increase). *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

TABLE 5 Longitudinal changes in quantitative indicators of depression (PHQ-9), anxiety (GAD-7), and PTSD (PCL-5) as a function of 5-level cross-sectional subjective attributions of pandemic-induced changes (i.e., large increase, small increase, no change, small decrease, large decrease)

	T1+	T2+	Time		Subjective change		Time × subjective change	
	%	%	F	p	F	p	F	p
PHQ-9	25.6	29.6	13.04	**3.38E−04**	2.79	0.03	3.04	**9.59E−03**
GAD-7	20.1	22.8	10.34	**1.39E−03**	2.54	0.04	1.63	0.17
PCL-5	12.1	10.8	0.21	0.65	5.07	**5.21E−04**	4.41	**1.67E−03**

Note: Significant effects are in boldface. T1+ and T2+ Percentage of people in the sample at T1 (pre-COVID) and T2 (intra-COVID) that reported scores of ≥10 PHQ, ≥10 GAD, and ≥32 PCL.

DISCUSSION

The current study examined correspondence between self-attributions of changes in drinking during the pandemic in relation to longitudinally measured changes in drinking-related behaviors. Approximately one-third of participants perceived increases, one-third perceived decreases, and one-third perceived no changes in

alcohol use during the pandemic, consistent with larger trends (e.g., Manthey et al., 2021; Statistics Canada, 2021b). These self-attributions mapped on to longitudinal changes to a large extent: the groups reporting increases and decreases did indeed exhibit significant respective increases and decreases in DD in the longitudinal data, and the group reporting no changes remained the same. A higher resolution analysis of the correspondence between
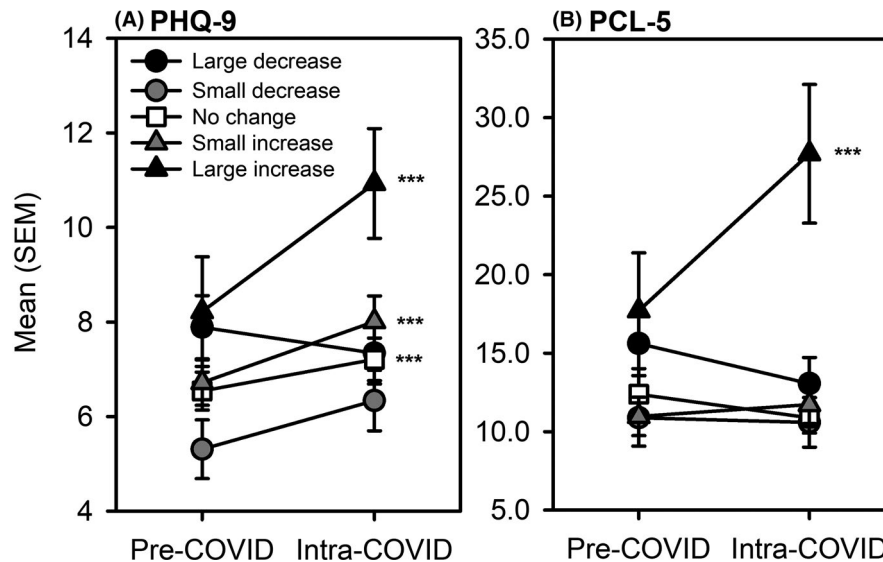
FIGURE 3 Longitudinal differences in depression (PHQ-9; Panel A), and PTSD (PCL-5; Panel B) as a function of five levels of self-attributions about changes in drinking (i.e., large decrease = ~60–100%; small decrease = ~10–30%; no change; small increase = ~10–30%; large increase = ~60–100+% increase). *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

self-attributions and longitudinal changes in drinking-related behaviors was also conducted. Here, too, self-attributions corresponded to longitudinal changes in DD per week remarkably well and within the categories of increases and decreases, distinct trajectories were clear based on small or large magnitude increases or decreases, suggesting that questions that probe for greater precision are capturing valid distinctions. Collectively, these findings suggest that self-attributions about pandemic-related drinking accurately reflected longitudinal changes, giving greater credence to the findings from large-scale survey-based findings.

Importantly, the questions about pandemic-related alcohol use asked about drinking in general, without distinguishing between moderate drinking, heavy drinking, or alcohol consequences. As such, in relation to the three longitudinal drinking outcomes, the question was most compatible with DD per week more than HDD or B-YAACQ. Although the findings for these latter outcomes were generally similar to DD, some potentially important nuances were also present. For example, self-attributions about decreases in drinking were associated with larger decreases in HDD and alcohol problems in the longitudinal data than anticipated. Specifically, those perceiving small decreases reported a 72.8% reduction in HDD and 56.9% reduction in the number of alcohol-related problems, and those reporting large decreases in drinking over the pandemic reported a 92.1% decrease in HDD and 77.9% reduction in alcohol-related problems. Thus, self-attributions for decreases were associated with larger decreases in the higher risk outcomes. Interestingly, among individuals reporting increases, an unexpected dissociation was present. Those perceiving small increases in drinking during the pandemic reported a modest 3.4% increase in HDD, but a 17% reduction in the number of alcohol-related problems. Thus, in this group, although DD and HDD increased, the overall level of alcohol severity did not. In contrast, those perceiving large increases in drinking

reported a 161.5% increase in HDD and a 37.2% increase in alcohol-related problems. This group represented a distinct high-risk group as all alcohol-related indices exhibited steep longitudinal increases. Finally, with regard to the group reporting no changes, it was notable that while that was accurate for DD, there was actually a 21.6% reduction in HDD and a 58% reduction in alcohol-related problems in the longitudinal data. This suggests that self-attributions about no change may actually underestimate positive reductions in heavy drinking and alcohol problems. Taken together, these results for HDD and alcohol problems suggest both correspondence with self-attributions about drinking in general, but salutary changes for risky drinking outcomes in four of the five groups, the exception being the subgroup reporting large increases.

A follow-up analysis was also conducted to examine whether high-resolution self-attributional changes in drinking were associated with changes in mental health outcomes. Here, there were significant Time × Subjective Change interactions present for depression and PTSD symptoms. Specifically, there were no changes in depression or PTSD symptoms in those perceiving decreases in their drinking during the pandemic, but the three other groups reported significant increases in depression. Notably, the group reporting a large increase in alcohol use also reported a significant increase in PTSD symptoms, perhaps suggesting drinking was used as a coping mechanism in these individuals. Also, of note, the proportion of individuals displaying a clinically significant increase (+5 points) in PTSD and depression was the highest in this group (Table S2). Interestingly, the proportion of individuals meeting the clinical threshold of depression and PTSD prior to the pandemic was similar in the large decrease and large increase group, suggesting a particularly adverse effect of the pandemic in the large increase group. One cause of this may be a significantly greater proportion reporting income loss in this group (Table S1). Overall, it is clear that the group with the

highest risk pandemic-related drinking changes also exhibited the most pronounced negative changes in mental health. Importantly, to put these changes in context, while there is a high comorbidity between alcohol use and PTSD (Keane & Kaloupek, 1997; McFarlane, 1998; Stewart, 1996), the scores in the high-risk group exhibiting a sharp spike in PTSD symptoms were almost entirely below the clinical screening cutoff of 33. This suggests the elevations did not reflect the presence of PTSD per se, so much as the substantive increases in PTSD symptom domains (e.g., negative affectivity, irritability, difficulty sleeping). Somewhat surprisingly, corresponding changes in anxiety symptoms were not observed.

These findings should be considered in the context of their strengths and limitations. First, a high-resolution operationalization of subjective change (i.e., approximate percent change) is not common and likely increased the strength of the association between the subjective item and DD. Therefore, this approach may be methodologically advantageous for future research using single-item measures of subjective change. Second, the longitudinal design of this study allowed self-attributions and alcohol consumption behaviors to be compared from before to during the COVID-19 lockdown, which is essential for examining the correspondence between the two. However, the prepandemic assessment varied in terms of timeframe, albeit within a structured window, and only constituted one prepandemic observation. As it has been noted that existing fluctuations are happening continuously, including prior to any event like COVID-19, a single pre-COVID timepoint is a necessary consideration (Jager & Keyes, 2021). Pandemic-related changes were assessed before drinking responses without counterbalancing to offset possible order effects. It should also be noted that this was a sample of heavy drinking emerging adults (engaging in at least one day of HED in the last month at initial enrollment), constraining the generalizability somewhat, and the participants were in an existing longitudinal cohort study and were thus familiar with periodically reporting their drinking behavior. In addition, it is possible self-attributions may vary by heaviness of drinking. Other considerations were that there was also no biological verification of self-reported drinking and there were small cell sizes within the 5-level analysis, therefore potentially making the observed results less robust. Lastly, much of the sample identified as of European/White ancestry, which limits generalizability to racial and ethnic minorities who have been disproportionately impacted by the pandemic (Statistics Canada, 2020a, 2020b, 2020c).

These analyses nonetheless provide substantive evidence that self-attributions about pandemic-related drinking show good correspondence with longitudinal data, generally supporting the accuracy of the results being reported from cross-sectional survey data. More specifically, using the items used herein may be expected to generate a generally valid evaluation of changes in alcohol use patterns, with the higher resolution options revealing subgroups with distinct clinical relevance. This has potential high public health significance insofar as most studies on pandemic impacts to date have been cross-sectional, reporting self-attributions about increases or decreases in behavior. Furthermore, the current findings reveal

heterogeneity that may also explain why some researchers report decreases in alcohol consumption (White et al., 2020), while others report increases (Lechner et al., 2020; Rodriguez et al., 2020), and these results identified a subset of individuals who are at particularly high risk (i.e., individuals reporting a very large increase). Although these individuals represented only a small minority of the sample, it is an ongoing priority to identify the population subgroups differentially experiencing adverse alcohol-related outcomes from the pandemic and provide appropriate resources to meet those needs.

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REFERENCES

Bates, D., Mächler, M., Bolker, B.M. & Walker, S.C. (2015) Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67, 1–48.

Blevins, C.A., Weathers, F.W., Davis, M.T., Witte, T.K. & Domino, J.L. (2015) The posttraumatic stress disorder checklist for DSM-5 (PCL-5): development and initial psychometric evaluation. *Journal of Traumatic Stress*, 28, 489–498.

Butt, P., Beirness, D., Gliksman, L., Paradis, C. & Stockwell, T. (2011) *Alcohol and health in Canada: a summary of evidence and guidelines for low risk drinking*. Ottawa ON: Canadian Centre on Substance Abuse.

CCSA. (2020) COVID-19 and Increased Alcohol Consumption: NANOS Poll Summary Report | Canadian Centre on Substance Use and Addiction. Available at: https://www.CCSA.ca/covid-19-and-increased-alcohol-consumption-nanos-poll-summary-report. [Accessed 13 June 2021].

Centre on Substance Use C. (2019) Alcohol (Canadian Drug Summary).

Clay, J.M. & Parker, M.O. (2020) Alcohol use and misuse during the COVID-19 pandemic: a potential public health crisis? *The Lancet Public Health*, 5, e259.

Collins, R.L., Parks, G.A. & Marlatt, G.A. (1985) Social determinants of alcohol consumption: the effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology*, 53, 189–200.

Del Boca, F.K. & Darkes, J. (2003) The validity of self-reports of alcohol consumption: state of the science and challenges for research. *Addiction*, 98, 1–12.

Fox, J. & Weisberg, S. (2019) *Applied regression 3E*. Sage Publications. Available at: https://socialsciences.mcmaster.ca/jfox/Books/Companion/ [Accessed 6th August 2021].

Frasquilho, D., Matos, M.G., Salonna, F., Guerreiro, D., Storti, C.C., Gaspar, T. et al. (2016) Mental health outcomes in times of economic recession: a systematic literature review Health behavior, health promotion and society. *BMC Public Health*, 16, 115.

Gili, A., Bacci, M., Aroni, K., Nicoletti, A., Gambelunghe, A., Mercurio, I. et al. (2021) Changes in drug use patterns during the covid-19 pandemic in Italy: monitoring a vulnerable group by hair analysis. *International Journal of Environmental Research and Public Health*, 18, 1–11.

Harris, P.A., Taylor, R., Minor, B.L., Elliott, V., Fernandez, M., O'Neal, L. et al. (2019) The REDCap consortium: building an international community of software platform partners. *Journal of Biomedical Informatics*, 95, 103208.

Jager, J. & Keyes, K.M. (2021) Is substance use changing because of the COVID-19 pandemic? Conceptual and methodological considerations to delineating the impact of the COVID-19 pandemic on substance use and disorder. *Addiction*, 116, 1301–1303.

Kahler, C.W., Hustad, J., Barnett, N.P., Strong, D.R. & Borsari, B. (2008) Validation of the 30-day version of the brief young adult alcohol consequences questionnaire for use in longitudinal studies. *Journal of Studies on Alcohol and Drugs*, 69, 611–615.

Keane, T.M. & Kaloupek, D.G. (1997) Comorbid psychiatric disorders in PTSD. Implications for research. *Annals of the New York Academy of Sciences*, 821, 24–34.

Kilian, C., Rehm, J., Allebeck, P., Braddick, F., Gual, A., Barták, M. et al. (2021) Alcohol consumption during the COVID-19 pandemic in Europe: a large-scale cross-sectional study in 21 countries. *Addiction*. Online ahead of print. https://doi.org/10.1111/add.15530

Kroenke, K., Spitzer, R.L., Williams, J.B.W. & Löwe, B. (2010) The patient health questionnaire somatic, anxiety. [Gen Hosp Psychiatry. 2010 Jul-Aug]—PubMed result. *General Hospital Psychiatry*, 32, 345–359.

Lechner, W.V., Laurene, K.R., Patel, S., Anderson, M., Grega, C. & Kenne, D.R. (2020) Changes in alcohol use as a function of psychological distress and social support following COVID-19 related University closings. *Addictive Behaviors*, 110, 106527.

Lenth. (2020) Package "emmeans" Type Package Title Estimated Marginal Means, aka Least-Squares Means. Available at: https://cran.r-project.org/web/packages/emmeans/emmeans.pdf [Accessed 6th August 2021].

Löwe, B., Unützer, J., Callahan, C.M., Perkins, A.J. & Kroenke, K. (2004) Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Medical Care*, 42, 1194–1201.

Manea, L., Gilbody, S. & McMillan, D. (2012) Optimal cut-off score for diagnosing depression with the Patient Health Questionnaire (PHQ-9): a meta-analysis. *Canadian Medical Association Journal*, 184, E191–E196.

Manthey, J., Kilian, C., Carr, S., Bartak, M., Bloomfield, K., Braddick, F. et al. (2021) Use of alcohol, tobacco, cannabis, and other substances during the first wave of the SARS-CoV-2 pandemic in Europe: a survey on 36,000 European substance users. *Substance Abuse: Treatment, Prevention, and Policy*, 16, 20.

McFarlane, A.C. (1998) Epidemiological evidence about the relationship between PTSD and alcohol abuse: the nature of the association. *Addiction Behavior*, 23, 813–825.

Minhas, M., Belisario, K., González-Roz, A., Halladay, J., Murphy, J.G. & MacKillop, J. (2021) COVID-19 impacts on drinking and mental health in emerging adults: longitudinal changes and moderation by economic disruption and sex. *Alcoholism, Clinical and Experimental Research*, 45, 1–10.

National Institute on Alcohol Abuse and Alcoholism (NIAAA). (2017) Drinking levels defined. Available at: https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking.

R Core Team (2020) *R: A language and environment for statistical computing [Computer software manual]*. Vienna: Austria. Retrieved from https://www.R-project.org

Reynolds, C.M.E., Purdy, J., Rodriguez, L. & McAvoy, H. (2021) Factors associated with changes in consumption among smokers and alcohol drinkers during the COVID-19 'lockdown' period. *Eur J Public Health*. Online ahead of print. https://doi.org/10.1093/eurpub/ckab050

Rodriguez, L.M., Litt, D.M. & Stewart, S.H. (2020) Drinking to cope with the pandemic: the unique associations of COVID-19-related perceived threat and psychological distress to drinking behaviors in American men and women. *Addictive Behaviors*, 110, 106532.

Rossow, I., Bye, E.K., Moan, I.S., Kilian, C. & Bramness, J.G. (2021) Changes in alcohol consumption during the covid-19 pandemic—small change in total consumption, but increase in proportion of heavy drinkers. *International Journal of Environmental Research and Public Health*, 18(8), 4231.

Spitzer, R.L., Kroenke, K., Williams, J.B.W. & Löwe, B. (2006) A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine*, 166, 1092–1097.

Statistics Canada. (2020) *Economic impact of COVID-19 among visible minority groups*. Available at: https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00042-eng.htm [Accessed 28th December 2020].

Statistics Canada. (2020) *Impacts of COVID-19 on immigrants and people designated as visible minorities*. Available at: https://www150.statcan.gc.ca/n1/pub/11-631-x/2020004/s6-eng.htm [Accessed 28th December 2020].

Statistics Canada. (2020) *Vulnerabilities related to COVID-19 among LGBTQ2+ Canadians*. Available at: https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00075-eng.htm [Accessed 28th December 2020].

Statistics Canada. (2021a) Alcohol and cannabis use during the pandemic: Canadian perspectives survey series, vol. 6, pp. 27–31.

Statistics Canada. (2021b) *Add/Remove data—detailed household final consumption expenditure, Canada, quarterly*. Available at: https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3610012401 [Accessed 15th February 2021].

Stewart, S.H. (1996) Alcohol abuse in individuals exposed to trauma: a critical review. *Psychological Bulletin*, 120, 83–112.

Toussaint, A., Hüsing, P., Gumz, A., Wingenfeld, K., Härter, M., Schramm, E. et al. (2020) Sensitivity to change and minimal clinically important difference of the 7-item Generalized Anxiety Disorder Questionnaire (GAD-7). *Journal of Affective Disorders*, 265, 395–401.

Tran, T.D., Hammarberg, K., Kirkman, M., Nguyen, H.T.M. & Fisher, J. (2020) Alcohol use and mental health status during the first months of COVID-19 pandemic in Australia. *Journal of Affective Disorders*, 277, 810–813.

White, H.R., Stevens, A.K., Hayes, K. & Jackson, K.M. (2020) Changes in alcohol consumption among college students due to COVID-19: Effects of campus closure and residential change. *Journal of Studies on Alcohol and Drugs*, 81, 725–730.

SUPPORTING INFORMATION

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