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Alcohol Consumption Patterns During Isolation from the COVID-19 Pandemic: Highlighting Negative Emotionality Mechanisms

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ABSTRACT

Objectives: The Coronavirus (COVID-19) pandemic has required drastic safety measures to control virus spread, including an extended period of self-isolation. Stressful situations increase alcohol craving and consumption in both Alcohol Use Disorder (AUD) and non-AUD drinkers. Thus, we assessed how COVID-19-related stress may have affected drinking behaviours in the general population.

Design: We developed an online cross-sectional survey, Habit Tracker (HabiT), which measured changes in drinking behaviours before (post-hoc recall) and during the COVID-19 quarantine period. We also assessed psychiatric factors such as anxiety, depression, and impulsivity. Lastly, we related drinking behaviours to COVID-19-specific stress factors.

Setting: HabiT was released internationally with individuals from 83 countries participating; a majority residing in the United Kingdom and United States.

Participants: Participants were included if they were 18 years of age or older, confirmed they were proficient in understanding English, and answered attentional checks correctly. The survey was completed by 2,873 adults with 1,346 usable data.

Primary and Secondary Outcome Measures: Our primary outcome measures were change in amount and severity of drinking behaviours before and during quarantine, and current drinking severity during quarantine. These three measures were related to ten COVID-19-related stress factors and current drinking severity to psychiatric symptomatology.

Results: Although drinking behaviors decreased overall during quarantine, 36% reported an increase in alcohol use. Those who increased alcohol use during quarantine were older individuals, males, essential workers, individuals with children, those with a personal relationship with someone severely ill from COVID-19, and those with higher depression, anxiety, or positive urgency impulsivity.

Conclusions: Our findings highlight a role for identifying those vulnerable for alcohol misuse during periods of enforced self-isolation and underscore the theoretical mechanism of negative emotionality underlying drinking behaviours driven by stress, depression, and anxiety. Future studies should aim to assess the long-term effects of isolation on drinking behaviours.

Keywords: COVID-19; alcohol use; stress; depression; self-isolation

ARTICLE SUMMARY

Strengths and limitations of this study

- The HabiT study sampled drinking behaviours of a large, diverse population during the COVID-19 pandemic.
- Changes in drinking behaviours were assessed against specific COVID-19-related stress factors.
- Due to the length of the survey (8-10 minutes), we observed a large degree of study dropout.
- Subjects were within varying phases of lockdown during the time of testing.
- The prevalence of diagnosed Alcohol Use Disorder drinkers sampled was low, likely related to sampling issues or under-reporting.

INTRODUCTION

The Coronavirus (COVID-19) pandemic has necessitated drastic safety measures to control the virus spread. These measures included an extended self-isolation period in which individuals were permitted to leave their places of residence only to obtain amenities or engage in essential work. Individuals were not permitted face-to-face contact with anyone who did not reside within their immediate households. In the United Kingdom, these measures were instituted nationally on March 23rd, 2020, with a gradual lifting of restrictions on May 10th, 2020 ending on July 4th, 2020 with locality-specific intermittent reinstatement of these measures. Although a necessary precautionary measure to mitigate the devastating effects of COVID-19 on public health, evidence indicates that protracted periods of self-isolation, especially in the context of stress, may be related to acute and prolonged negative mental health consequences, particularly in individuals already struggling with psychiatric disorders.[1]

Indeed, current clinical reports from individuals in treatment for Substance Abuse Disorder indicate that the stress produced by COVID-19 social isolation measures have triggered greater and more frequent drug or alcohol cravings, subsequently leading to relapse.[2] This observation is relevant to a prominent mechanistic theory of negative emotionality underlying alcohol misuse.[3] The relationship between stress and alcohol consumption is widely recognised and can be observed in an experimental fashion.[4] In subjects with known Alcohol Use Disorder (AUD), stress and experimental manipulations of stress enhance the amount of alcohol consumed [5, 6], alcohol craving [7], problematic drinking behaviours, and likelihood of relapse.[8] Exposure to stress triggers relapse characterised by a re-instantiation of alcohol cravings and alcohol-seeking behaviours.

Increases in alcohol craving and consumption after stress exposure also occur in those without AUD. An increase in alcohol consumption is often used as a coping strategy for both chronic and specific stressful life events in both AUD and non-AUD drinkers.[9] Similarly in both groups, self-reported craving and subjective judgements of alcohol value rise following a stress task [10], and social drinkers consume more alcohol after witnessing a social stressor.[11] These relationships are moderated by age [12], gender, previous alcohol exposure [12], underlying personality traits [13], alcohol expectancies [14], and the pattern of alcohol consumption.[15]

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5 Thus, in response to these exceptional circumstances, we aimed to assess how social isolation
6 measures in the midst of the COVID-19 pandemic may have affected drinking behaviours in the
7 general adult population. We developed an international survey, entitled Habit Tracker (HabiT),
8 which evaluated drinking severity before (post-hoc recall) and during the COVID-19 quarantine
9 period. We hypothesised that changes in amount of alcohol consumption and severity of drinking
10 behaviours may be related to specific COVID-19 related stress factors, as well as demographic
11 and psychiatric factors. Further, we investigated if COVID-19-related stress factors influenced
12 changes in drinking amount, drinking severity, depression, and anxiety before and during
13 quarantine.
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21 **METHODS**

22 **Recruitment and inclusion criteria**

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26 The HabiT survey was a questionnaire that sought to assess the effects of isolation on alcohol,
27 smoking, and internet use. The effects on alcohol use are reported here. Subjects were included if
28 they were 18 years of age or older and confirmed they were proficient in reading and
29 understanding English. HabiT was advertised by University of Cambridge news page on May
30 11th, 2020, a day before its international release. For the next several days, the survey was
31 disseminated by news agencies throughout the UK (e.g., The Telegraph, BBC Cambridgeshire,
32 News Wise) as well as throughout various University of Cambridge colleges. Further, the survey
33 was posted and shared on personal and public social media sites (i.e., Facebook, Twitter). HabiT
34 was approved by the Cambridge Psychology Research Ethics Committee. All subjects gave
35 informed consent and were not financially compensated for their participation. The data
36 collected was fully anonymized. The survey was created using Qualtrics (Provo, Utah) survey-
37 building platform. The average time to complete the survey was approximately 8-10 minutes and
38 all subjects could participate on either a computer or smart phone device.
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50 **Patient and public involvement statement**

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54 We did not involve patients or the public in the research design, reporting, or dissemination
55 strategies of this study.
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Demographic information

The demographic information collected were as follows: age, gender, socioeconomic status, intimate relationship status, country and city of residence, and any previous or current diagnosis of a psychiatric or neurological disorder.

Attentional checks

Every major section of the survey contained at least one question which served as an attentional check to ensure subjects were correctly reading and answering survey questions to the best of their ability. The attentional checks were structured to mirror the Likert scaling of each section (e.g., “If you are reading this question, please select ‘Strongly Agree.’”).

Frequency and severity of alcohol consumption before and during the quarantine period

We first asked subjects if they drank alcohol. If the answer was negative, they proceeded to the next set of questions. If the answer was positive, we assessed the change in the amount and severity of alcohol use as well as the current severity of alcohol use. We asked subjects to report the following behaviours within a typical week in November (i.e. pre-quarantine) and within the last week (i.e. during quarantine): (i) the number of units of alcohol consumed within the last week with examples for the number of units for differing types of alcohol and sizes provided; (ii) the change in severity using a time-scale adaptation of the first three questions of the Alcohol Use Disorders Identification Test (AUDIT-C).[16] Subjects were asked to report how many days in the last week they consumed an alcoholic beverage, how many drinks they consumed on a typical day they were drinking in the last week, and how often they consumed six or more drinks on one occasion in the last week. To assess the current severity of drinking behaviours during quarantine, we used a timescale-adapted version of the full AUDIT [17] which assessed problem drinking behaviours within the last week such as an inability to stop drinking once started, failure to perform responsibilities, feeling guilt or remorse, drinking shortly after waking to ease the adverse physiological effects of drinking the night before, drinking to the point of memory loss, injuring oneself or others due to drinking, and concern from a loved one or medical professional related to the frequency or severity of one’s drinking. We used two primary outcome measures:

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3 the change in severity (AUDIT-C) corroborated with the secondary change in amount of
4 drinking (units per week) and current severity (full AUDIT).
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7 **COVID-19-related stress scale**

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10 We assessed 10 factors which may contribute to COVID-19-related stress using the following
11 questions:
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- 14 1. Have you been deemed an "essential worker" by your government?
- 15 2. Do you work for health care services specifically with individuals who have contracted
16 Coronavirus (COVID-19)? (Sub-question of question 1)
- 17 3. Has your employment situation changed due to the Coronavirus (COVID-19) crisis?
- 18 4. Has anyone you know personally contracted or have shown symptoms characteristic of
19 Coronavirus (COVID-19)?
- 20 5. Has anyone you know personally become severely ill or died due to contracting
21 Coronavirus (COVID-19)?
- 22 6. Are you isolated alone?
- 23 7. Do you have children?
- 24 8. If you have children, are you their only caretaker? (Sub-question of question 7)
- 25 9. If you are currently in isolation with others, how would you describe the quality of your
26 relations?
- 27 10. How often do you currently go outdoors (for work, essential duties, leisure, etc.)?
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40 **Psychiatric measures**

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42 Depression and anxiety symptomology were measured using The Hospital Anxiety and
43 Depression Scale (HADS); a brief, validated four-item questionnaire.[18] As a secondary
44 analysis, we assessed impulsivity using the validated Short UPPS-P Impulsive-Behavior Scale
45 (SUPPS-P).[19] This scale provides an overall impulsivity score, as well as five scores
46 corresponding to impulsivity subscales: perseveration, lack of premeditation, sensation-seeking,
47 negative urgency, and positive urgency.
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Statistical analysis

Statistical analyses were performed using MATLAB (Version 2020a). All subjects who answered the attentional checks incorrectly, reported highly improbable answers regarding the units of alcohol they consumed weekly (e.g., 1,000 units), did not report their gender, or did not complete the psychiatric questionnaires were excluded from further analysis, leaving a total of 1346 subjects. Drinking severity scores of the sample were non-normally distributed (Shapiro-Wilk, $p < .05$), thus non-parametric tests were used.

We used Mann-Whitney U-tests to compare weekly alcohol unit consumption and alcohol severity before and during quarantine in the full group. Then, we divided subjects into three groups, those who during quarantine either increased, decreased, or did not change their alcohol consumption and performed a Kruskal-Wallis H-test to assess the relative drinking amount to severity indices of these groups.

We then assessed which COVID-19-related stress factors were associated with changes in either amount (alcohol units consumed per week), change in severity (AUDIT-C), current severity (full AUDIT), or current depression and anxiety using the following tests: 1) Mann-Whitney U-Tests to compare negative versus positive responses to the COVID-19 stress items (MW), 2) MANCOVA [20] controlling for gender and age (MAN1), and 3) A second MANCOVA controlling for age, gender, depression, and anxiety symptomology (MAN2). For the MANCOVA tests, variables 'age,' 'depression severity,' and 'anxiety severity' were dichotomised via median split. For the COVID-19 stress primary item comparisons (eight items), we used False Discovery Rate (FDR) to control for multiple comparisons with significance assigned at $p < .05$. [21, 22]

On an exploratory basis, we then used Spearman's partial correlation to compare the drinking severity indices of subjects who completed the timescale-adapted AUDIT with SUPPS-P and HADS scores to relate drinking severity of the overall sample to psychiatric measures. Lastly, in order to assess possible directional relationships in changes in the severity of drinking behaviors to depression, anxiety, and impulsivity; we performed Spearman's partial correlations with the psychiatric questionnaires among the three aforementioned groups (i.e., increased, decreased,

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3 and null). For both correlational analyses, we used FDR correction ($p < .05$) for multiple
4 comparisons.
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7 8 **RESULTS**

9 10 **Demographic information**

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12 A total of 2,873 subjects participated (data collection: 05/12/2020 to 05/28/2020) of which 1,346
13 had usable data based on defined criteria. Of these subjects, 859 reported that they drink alcohol.
14 Of the 1346 subjects, the average age was 28.92 ± 10.45 years (range= 18-90) with more males
15 (males: $n= 1006$; females: $n=325$; other: $n=15$) from 85 different countries of residence, with the
16 majority from the United Kingdom ($n= 434$) and the United States ($n= 355$). Marital status was
17 as follows: single: $n=785$; married or committed: $n=571$; divorced or separated: $n=33$; widowed:
18 $n=4$. Socioeconomic status was as follows: <19.9k: $n=285$; 20-39.9k: $n= 273$; 20-39.9k: $n=244$;
19 40-69.9k: $n=241$; 70-99.9k: $n=141$; >100k: $n=203$; and 232 subjects did not report their incomes.
20 Current psychiatric or neurological diagnoses were as follows: no diagnosis: $n=1192$; depression:
21 $n= 60$; anxiety: $n= 38$, Post-Traumatic Stress Disorder (PTSD): $n= 5$, comorbid depression and
22 anxiety: $n= 46$.
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32 33 **Overall changes in drinking frequency and severity before and during quarantine**

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35 Of the total sample, the change in problem drinking severity (AUDIT-C) was a decrease in 0.89
36 ± 1.43 (range: 0-8) and the mean change in the amount consumed was 5.62 ± 9.55 units (range:
37 0-120). The current problem drinking severity (full AUDIT) was 3.14 ± 4.47 (range: 0-32), with
38 557 subjects included that do not consume alcohol. Of the subjects who reported they consume
39 alcohol ($n= 859$), the change in severity from pre-quarantine to quarantine was a decrease of 1.53
40 ± 1.6 , range 0-8 ($U= 2.65$, $p= .008$). The units of alcohol consumed per week was significantly
41 decreased during the quarantine period (8.03 ± 14.22 units, range= 1-120) compared to
42 November (8.32 ± 11.92 units, range = 0-150), $U= -2.29$, $p= .02$ (Figure 1). More subjects
43 reported a decrease ($n= 384$, 45%) or an increase ($n= 308$, 36%) as opposed to no change ($n=$
44 166 , 19%) of weekly alcohol consumption from November to the quarantine period ($X^2= 72.86$,
45 $p = .001$; Figure 1). Of the three groups, those who: 1) increased weekly units consumed during
46 quarantine (7.5 ± 10.5 change in units, range: 1-80), 2) decreased weekly units consumed during
47 quarantine (-6.5 ± 9.5 change in units, range: $-.2 - -120$), and 3) did not change their weekly unit
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3 consumption, subjects who had increased the units of alcohol consumed during the quarantine
4 period showed significantly higher current drinking severity scores (7.5 ± 5.6 , range: 1-32) than
5 those who reported decreases (3.5 ± 3.0 , range: 1-21) or no changes (4.8 ± 3.6 , range: 1-20) in
6 weekly unit consumption ($H= 165.33$, $p < .0001$).
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11 [INSERT FIGURE 1 & FIGURE 1 LEGEND HERE]
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14 **COVID-19 stress item analysis**

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16 The change in amount of drinking was positively correlated with age ($r_s = 0.2$, $p < .0001$), and
17 gender with males (6.44 ± 10.8 units, range: 0-120) showing an increase in drinking behaviours
18 relative to females (3.81 ± 5.18 , range: 0-38) or other genders (1.32 ± 1.65 , range: 0-5) ($H= 8.17$,
19 $p = .003$). Changes in drinking severity were also related to both age and gender, with older
20 individuals ($r_s = .2$, $p < .0001$) and males (1.68 ± 1.74 , range: 0-8) demonstrating greater changes
21 in their drinking severity than females (1.16 ± 1.12 , range: 0-8) and others (1.36 ± 1.29 , range: 0-
22 3) ($H= 6.02$, $p = .05$). Thus, we utilised age and gender as covariates for both MANCOVA
23 analyses. All relevant covariates used in these analyses were dichotomised via median split (age=
24 25.1 years, depression severity= 2, and anxiety severity= 1).
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33 **Primary COVID-19 stress items**

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35 The influence of COVID-19 stress items on the change in drinking severity, amounts consumed,
36 and current drinking severity are reported in Tables 1, 2, and 3, respectively. Designated
37 essential workers and those with children showed a greater increase in the amount consumed
38 weekly and drinking severity as well as greater current severity. This remained significant
39 including when controlled for demographic variables (age, gender) and psychiatric symptoms
40 (depression, anxiety). Notably, although subjects with children reported an increase in the
41 number of units of alcohol and severity of alcohol use, they also reported lower levels of
42 depression and anxiety. Knowing an individual personally who was ill or severely ill with Covid-
43 19 showed higher current alcohol drinking severity than those who did not, but with no change
44 from pre- to post-quarantine. A reported change in employment status and isolating alone was
45 associated with greater depression scores, with no differences in drinking behaviours. Isolating
46 with others but reporting a poor relationship was associated with greater depression and anxiety,
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however, the lower drinking behaviours were moderated by age and gender effects. Finally, going outdoors was associated with greater current drinking severity and greater depression and anxiety scores controlling for all variables. Post-hoc tests confirmed that, in cases in which a significant relationship was lost between an item and either changes in drinking frequency or severity due to controlling for age and gender (i.e., MANCOVA 1), age was the sole contributor (Essential worker: $F(1, 533.2) = 7, p = .008$; Others ill: $F(1, 879.9) = 52.6, p < .0001$; Poor relationship: $F(1, 933.9) = 48.88, p < .0001$).

Stress Factor	N Total	Yes M(SD)	N Yes	No M(SD)	N No	MW p-value	MAN1 p-value	MAN2 p-value
Essential worker	1337	0.16(1.9)	241	-0.21(1.6)	1096	0.02*	0.01*	0.01*
Employment	1337	-0.14(1.8)	323	-0.14(1.6)	1014	0.83	0.96	0.92
Others ill	1334	-0.17(1.8)	497	-0.12(1.6)	837	0.75	0.64	0.63
Others severely ill	1336	-0.01(2)	127	-0.15(1.6)	1209	0.35	0.7	0.69
Isolated alone	1325	-0.1(1.9)	168	-0.15(1.6)	1157	0.83	0.85	0.82
Having children	1334	0.34(1.4)	209	-0.23(1.7)	1125	<.0001*	0.005*	0.003*
Poor relationship	1168	-0.3(1.7)	187	-0.13(1.6)	981	0.35	0.7	0.69
Going outdoors	1336	-0.27(1.3)	193	-0.12(1.7)	1143	0.26	0.7	0.69

Table 1. COVID-19 primary stress items relationship with changes in drinking severity (as indexed by the AUDIT-C) from pre-quarantine to quarantine.

Stress Factor	N Total	Yes M(SD)	N Yes	No M(SD)	N No	MW p-value	MAN1 p-value	MAN2 p-value
Essential worker	1337	1.26(12.8)	241	0.45(7.5)	1096	0.0003*	0.07	0.08
Employment	1337	0.17(11.2)	323	0.13(7.8)	1014	0.77	0.95	0.97
Others ill	1334	0.05(7.1)	497	0.2(9.6)	837	0.83	0.95	0.97
Others severely ill	1336	0.06(7.6)	127	0.15(8.9)	1209	0.83	0.95	0.97
Isolated alone	1325	0.05(11.6)	168	0.2(8.2)	1157	0.46	0.95	0.97
Having children	1334	2.02(11.9)	209	0.54(7.9)	1125	<.0001*	0.04*	0.02*
Poor relationship	1168	0.4(6.1)	187	0.19(8.7)	981	0.46	0.95	0.97
Going outdoors	1336	1.23(6.8)	193	0.04(9.0)	1143	0.15	0.47	0.4

Table 2. COVID-19 primary stress items relationship with changes in drinking amount (in units) from pre-quarantine to quarantine.

Stress Factor	N Total	Severity Type	Yes M(SD)	N Yes	N M(SD)	N No	M-W p-value	MAN1 p-value	MAN2 p-value
Essential worker	1337	Drinking	4.42(5.7)	243	2.85(4.1)	1099	<.0001*	0.0005*	0.0005*
		Depression	2.29(1.8)	243	2.44(1.9)	1099	0.43	0.84	
		Anxiety	1.79(1.7)	243	1.94(1.8)	1099	0.42	0.8	
Employment	1337	Drinking	3.46(4.9)	324	3.02(4.3)	1018	0.38	0.08	0.144

change		Depression	2.78(2.0)	324	2.31(1.9)	1018	0.0043*	0.007*	
		Anxiety	2.03(4.5)	324	1.88(1.8)	1018	0.32	0.363	
Others ill	1334	Drinking	3.59(1.9)	499	2.87(4.4)	840	<.0001*	0.1	0.125
		Depression	2.3(1.8)	499	2.47(1.9)	840	0.20	0.83	
		Anxiety	1.9(5.5)	499	1.93(1.9)	840	0.99	0.94	
Others severely ill	1336	Drinking	4.49(2.0)	127	2.99(4.3)	1214	0.001*	0.007*	0.01*
		Depression	2.45(2.0)	127	2.4(1.9)	1214	0.99	0.41	
		Anxiety	1.92(5.8)	127	1.91(1.8)	1214	0.82	0.84	
Isolated alone	1325	Drinking	3.88(2.0)	169	2.98(4.2)	1161	0.42	0.83	0.87
		Depression	3.4(1.9)	169	2.41(1.9)	1161	0.009*	0.04*	
		Anxiety	2.04(5.2)	169	1.9(1.8)	1161	0.43	0.11	
Having children	1334	Drinking	5.17(1.8)	211	2.75(4.2)	1128	< .0001*	0.0003*	<.0001*
		Depression	1.5(1.7)	211	2.58(1.9)	1128	<.0001*	<.0001*	
		Anxiety	1.37(1.7)	211	2.02(1.9)	1128	<.0001*	0.0009*	
Poor relationship	1168	Drinking	2.82(5.1)	187	3.1(4.1)	985	0.01*	0.92	0.87
		Depression	3.57(2.0)	187	2.2(1.8)	985	<.0001*	<.0001*	
		Anxiety	2.79(2.0)	187	1.74(1.8)	985	<.0001*	<.0001*	
Going outdoors	1336	Drinking	3.42(4.5)	1148	1.37(3.4)	193	<.0001*	<.0001*	<.0001*
		Depression	3.18(2.0)	193	2.28(1.9)	1148	<.0001*	<.0001*	
		Anxiety	2.42(2.0)	193	1.83(1.8)	1148	0.0002*	0.0008*	

Table 3. COVID-19 primary stress items relationship with current drinking severity (i.e., full AUDIT), depression, and anxiety from pre-quarantine to quarantine.

Secondary COVID-19 stress items

Two COVID-19 stress items were considered secondary as they represented a subset of a primary item. Working for health care services was associated with a trend towards a greater change in amount of units consumed ($F=3.97$, $p=.05$) and greater severity of current drinking ($F=7.01$, $p=.007$) when controlled for all variables. Being the only caretaker for children was also associated with greater change in drinking severity ($U=2.62$, $p=.009$) and greater change of amount consumed ($U=2.67$, $p=.007$), but was no longer significant when controlling for age and gender.

Drinking severity during quarantine and correlations with psychiatric measures

Of the individuals who reported drinking alcohol, ($n=769$) completed the current drinking severity index (e.g., the adapted-timescale AUDIT). The severity of drinking behaviours was positively related to depression ($r_s=.12$, $p=.004$), anxiety ($r_s=.12$, $p=.027$), and positive urgency impulsivity ($r_s=.12$, $p=.004$), controlled for age and gender. To assess potential directional relationships between current drinking severity during quarantine and psychiatric

measures, we correlated depression, anxiety, and impulsivity with the three drinking groups (i.e., increased, decreased, null). Drinking severity scores in the decreased and no change groups were not significantly correlated with any of the psychiatric measures of interest. However, drinking severity of those who increased their units consumed during the quarantine period were related to depression ($r_s = .30, p < .0001$), anxiety ($r_s = .23, p = .0002$), and positive urgency ($r_s = .17, p = .009$) (Figure 2).

[INSERT FIGURE 2 & FIGURE 2 LEGEND HERE]

DISCUSSION

We show an overall decrease in amounts and severity of problem alcohol use from pre-quarantine to the quarantine period. Critically, however, three different subpopulations were identified with most either increasing or decreasing use as compared to remaining unchanged in their alcohol use behaviours. Greater drinking was associated with demographic factors including age and male gender, COVID-19 stress-related factors, and psychiatric factors such as depression, anxiety, or the impulsivity subscale of positive urgency. Our findings underscore the theoretical mechanism of negative emotionality underlying drinking behaviours driven by stress, depression, and anxiety.

An overall decrease in alcohol use and problematic use may have multiple potential etiologies. Stringent lockdown may be associated with a decrease in the presence or availability of alcoholic beverages within the immediate household given limitations in access, a decrease in exposure to alcohol cues that may trigger urges, or the preference to consume alcohol within social contexts. More subjects reported either decreasing or increasing the frequency of their alcohol intake as compared to remaining unchanged, consistent with previous reports of a greater tendency toward extremes in individual drinking patterns when faced with either acute or chronic life stressors.[15]

Older individuals and males also showed a greater increase in drinking behaviours during lockdown and current severity of problem drinking consistent with demographic factors known to be associated with alcohol misuse. A meta-analysis focusing on gender-specific differences in

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3 drinking behaviors shows that females are more likely to be lifetime non-drinkers, drink less
4 overall, and exhibit fewer problem drinking behaviours in stressful and non-stressful
5 contexts.[23] Also, whether one increases their drinking after experiencing acute or chronic life
6 stress is age-dependent, which may reflect a function of previous alcohol experience.[12] Age
7 may play a particularly unique role in the context of COVID-19 due to the greater need for
8 stringent isolation with age, potentially fewer supports, and the risk of greater isolation,
9 loneliness, and concern about the impact of COVID-19 on one's personal health.

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12 COVID-19 specific stress factors appear to influence drinking behaviours controlled for other
13 confounding variables. Being deemed an essential worker and having children was associated
14 with a greater increase in drinking behaviours during quarantine. Importantly, although having
15 children was associated with an increase in alcohol use, depression and anxiety scores were
16 lower than in those without children. This suggests the additional burden of childcare and home
17 schooling contributed to the tendency towards drinking possibly in the context of stress relief and
18 was not mediated by greater depression or anxiety symptoms. The presence of children may also
19 be protective against depressive and anxiety symptoms during lockdown. Having children may
20 mitigate against loneliness that has been highlighted as a major issue during the isolation of
21 lockdown.[24] A subset of the essential worker category – health care workers responsible for
22 taking care of individuals with COVID-19 – was associated with greater severity of problem
23 drinking behaviours. Thus, the specific impact of lockdown on the necessity for essential
24 workers and the impact of the burden of home schooling and childcare on parents appears to
25 enhance drinking behaviours independent of an impact on psychiatric symptomatology.

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28 As expected, having a personal relationship with someone who had become severely ill or died
29 due to COVID-19 was associated with a greater increase in severity of problem drinking
30 behaviours. Going outdoors more frequently for work, exercise, or essential duties during
31 lockdown was similarly associated with greater severity of alcohol use, as well as depressive and
32 anxiety symptoms. The reasons behind the need to go outdoors complicate the interpretation, as
33 it might be confounded by being an essential worker but also allow for greater access to the
34 purchase of alcohol. Living with others but having a poor quality of relationship was
35 unexpectedly associated with a lower drinking severity but with greater depressive and anxiety

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3 symptoms. Living alone was not associated with any changes in drinking behaviours but was
4 associated with greater depressive symptomatology. These findings might support the role of
5 drinking in the context of social interactions; and further highlight the importance of social
6 interactions during lockdown, the role of loneliness, and its impact on mental health.
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11 We further observed a relationship between the current severity of drinking behaviours and
12 psychiatric symptoms such as depression, anxiety or positive urgency. These relationships were
13 driven particularly by the group which increased their drinking during quarantine. That both
14 negative and positive emotionality factors are associated with increased drinking behaviours is in
15 keeping with the multiple paths towards alcohol use. The effects of depression and anxiety on
16 alcohol consumption in both AUD and non-AUD drinkers are well-documented [25-28] and
17 related to mechanistic theories of negative emotionality, which suggest that individuals may
18 increase their alcohol consumption in stressful contexts to cope with aversive emotional
19 states.[3] Positive emotional factors appear to also play a role in the association with positive
20 urgency, a subtype of impulsivity characterised by the propensity to engage in disinhibited
21 behaviors including alcohol consumption when experiencing an intensified hedonic or excited
22 state.[29] Positive affect-based impulsivity may reflect a heightened reward sensitivity
23 associated with problem drinking behaviours.[30]
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35 **Limitations and future directions**

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37 This study is not without limitations. The study is a cross-sectional retrospective survey and
38 hence potentially limited by recall bias and lack of longitudinal follow-up. Because the aim of
39 the HabiT study was to investigate changes in frequency and severity of drinking behaviour in a
40 large, wider population, we issued the survey internationally and during a later period of
41 enforced isolation. Thus, the possibility cannot be overlooked that subjects were within varying
42 phases of lockdown characterised by differential restrictions during the time of testing which
43 may have influenced our current results. Also, approximately half of the individuals who began
44 the survey did not complete it. This may be due to the length of the survey (i.e., 8-10 minutes).
45 Prospective studies using an online survey design should further condense questionnaires in
46 order to attenuate dropout. The current HabiT survey only assessed the *acute* effects of COVID-
47 19 isolation measures on changes in drinking behaviours in comparison to the pre-quarantine
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3 period. Hence, follow-up studies should be employed during the immediate post-quarantine
4 period to investigate the possible protracted effects of COVID-19 isolation on drinking
5 behaviours. Furthermore, whether the sampling adequately reflects the population distribution in
6 the form of sampling bias may be an issue with online questionnaires and may under-represent
7 those that do not have access to the internet, have limited facility with online questionnaires, or
8 those that are more severely ill. As few respondents reported a previous history of alcohol
9 problems relative to the expected prevalence rates, the reporting is likely either a sampling bias
10 issue or limited willingness to reveal such a history in an online survey. This limits our capacity
11 to assess the change in drinking behaviours in those with a history of alcohol problems. Further
12 studies focusing specifically on the newly abstinent or those with a history of alcohol problems
13 are indicated.
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23 CONCLUSION

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25 Although alcohol drinking behaviours appeared to decrease overall during lockdown, we
26 emphasise that specific groups may be at higher risk for developing problematic alcohol use
27 behaviours. In particular, factors associated with an increase in alcohol use include older
28 individuals, males, essential workers, parents with children, those with a personal relationship
29 with someone severely ill from COVID-19, and those with higher depression, anxiety levels, or
30 positive urgency impulsivity. We emphasise that those with a previous history of alcohol misuse
31 or a family history of AUD were not the specific focus of this study and may represent a high
32 risk group which requires further investigation. Alcohol can be used in brief, moderate amounts
33 in a healthy, non-pathological manner related to socialisation and stress relief. However, a
34 subgroup of these individuals may still be at higher risk for longer term issues with alcohol
35 misuse. The lockdown resulted in a unique set of stressors that in some cases may persist (e.g.
36 childcare, grieving, prolonged depression or anxiety related to the lockdown) and might again re-
37 emerge with the imposition of localised lockdowns or further lockdowns in the context of a
38 second wave. Further studies on the longitudinal impact and persistence of these behaviours are
39 critical. Our findings highlight a need for identifying those at greater risk for alcohol misuse to
40 aim for greater support services and proactively target mental health issues associated with
41 problem drinking behaviours such as depression or anxiety.
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9 potential conflicts of interest.
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13 **Author Contributions:** SS created the HabiT survey, collaborated with VR in analysing the
14 collected data, and drafted and edited the manuscript. VR coded and analysed the data. HBJ
15 collaborated with VV in conceptualising the study. VV conceptualised the study, gave crucial
16 guidance in creating the HabiT survey, and edited the manuscript.
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22 **Data Statement:** All participant data used in this research is deidentified. Participant data and
23 MATLAB statistical code used for analysis is available upon reasonable request from
24 corresponding author, Samantha N. Sallie, at habittstudy2020@gmail.com.
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30 LEGENDS FOR FIGURES

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32 Figure 1. Changes in amount and severity of drinking behaviours in the HabiT sample between
33 pre-quarantine and quarantine periods. Units of alcohol consumed weekly (top left) and changes
34 in drinking severity (AUDIT-C) (bottom right) decreased during the quarantine period and more
35 individuals either increased or decreased their weekly units consumed during quarantine than
36 remained the same (top right). Further, those who increased their weekly alcohol unit
37 consumption during the quarantine period had significantly higher drinking severity indices (full
38 AUDIT) compared to those who decreased or did not change their drinking behaviours during
39 the quarantine period (bottom left).
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47 Figure 2. Regression plots of the significant relationships between drinking severity and
48 psychiatric measures in subjects who increased weekly alcohol unit consumption during
49 quarantine. Drinking severity indices of the group who increased their drinking during the
50 quarantine period were significantly positively related to depression severity, anxiety severity,
51 and positive urgency (impulsivity subset).
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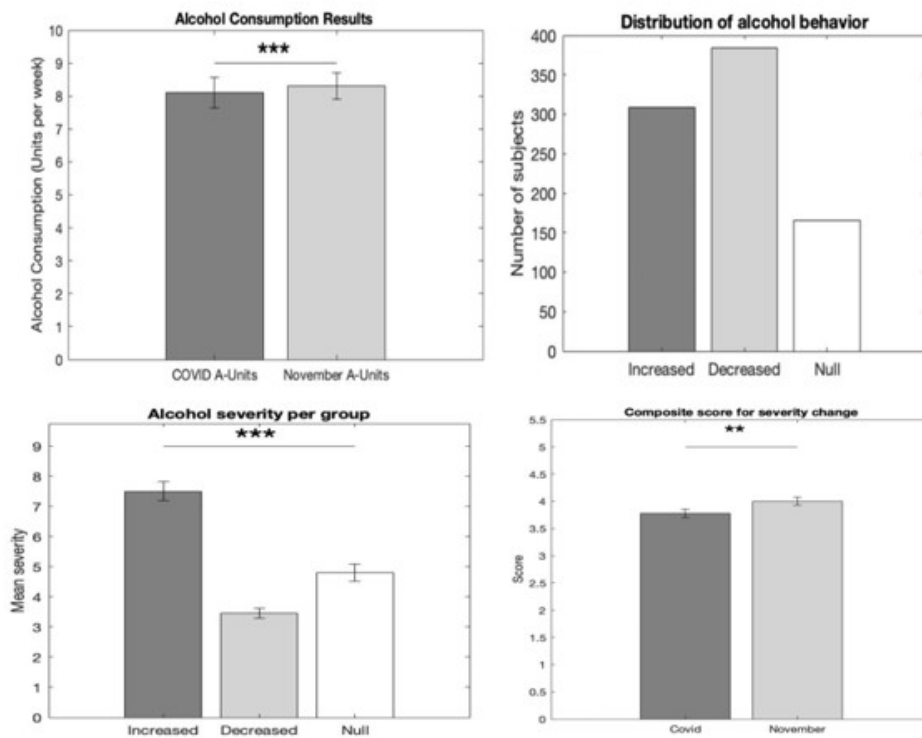


Figure 1. Changes in amount and severity of drinking behaviours in the HabiT sample between pre-quarantine and quarantine periods. Units of alcohol consumed weekly (top left) and changes in drinking severity (AUDIT-C) (bottom right) decreased during the quarantine period and more individuals either increased or decreased their weekly units consumed during quarantine than remained the same (top right). Further, those who increased their weekly alcohol unit consumption during the quarantine period had significantly higher drinking severity indices (full AUDIT) compared to those who decreased or did not change their drinking behaviours during the quarantine period (bottom left).

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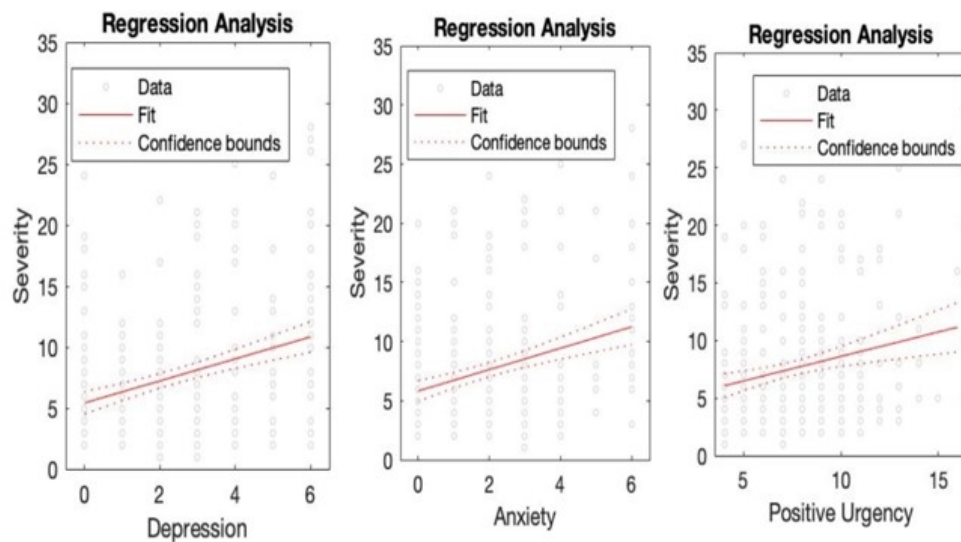


Figure 2. Regression plots of the significant relationships between drinking severity and psychiatric measures in subjects who increased weekly alcohol unit consumption during quarantine. Drinking severity indices of the group who increased their drinking during the quarantine period were significantly positively related to depression severity, anxiety severity, and positive urgency (impulsivity subset).

175x97mm (96 x 96 DPI)

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

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		Page
	Reporting Item	Number
Title and abstract		
Title	#1a Indicate the study's design with a commonly used term in the title or the abstract	1

1	Abstract	#1b	Provide in the abstract an informative and balanced	2
2			summary of what was done and what was found	
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6	Introduction			
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10	Background /	#2	Explain the scientific background and rationale for the	4
11	rationale		investigation being reported	
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15	Objectives	#3	State specific objectives, including any prespecified	5
16			hypotheses	
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20	Methods			
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23	Study design	#4	Present key elements of study design early in the paper	5
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26	Setting	#5	Describe the setting, locations, and relevant dates,	5
27			including periods of recruitment, exposure, follow-up, and	
28			data collection	
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31	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods	5
32			of selection of participants.	
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40		#7	Clearly define all outcomes, exposures, predictors,	6-7
41			potential confounders, and effect modifiers. Give	
42			diagnostic criteria, if applicable	
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47	Data sources /	#8	For each variable of interest give sources of data and	6-7
48	measurement		details of methods of assessment (measurement).	
49			Describe comparability of assessment methods if there is	
50			more than one group. Give information separately for for	
51			exposed and unexposed groups if applicable.	
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1	Bias	#9	Describe any efforts to address potential sources of bias	7-8
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4	Study size	#10	Explain how the study size was arrived at	7-8
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7	Quantitative	#11	Explain how quantitative variables were handled in the	8
8	variables		analyses. If applicable, describe which groupings were	
9			chosen, and why	
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15	Statistical	#12a	Describe all statistical methods, including those used to	8
16	methods		control for confounding	
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20	Statistical	#12b	Describe any methods used to examine subgroups and	8
21	methods		interactions	
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26	Statistical	#12c	Explain how missing data were addressed	7-8
27	methods			
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31	Statistical	#12d	If applicable, describe analytical methods taking account	N/A
32	methods		of sampling strategy	
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36	Statistical	#12e	Describe any sensitivity analyses	8
37	methods			
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42	Results			
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45	Participants	#13a	Report numbers of individuals at each stage of study—eg	9
46			numbers potentially eligible, examined for eligibility,	
47			confirmed eligible, included in the study, completing	
48			follow-up, and analysed. Give information separately for	
49			for exposed and unexposed groups if applicable.	
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57	Participants	#13b	Give reasons for non-participation at each stage	8
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1	Participants	#13c	Consider use of a flow diagram	N/A- Cross-
2				sectional
3				survey
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11	Descriptive data	#14a	Give characteristics of study participants (eg	9
12			demographic, clinical, social) and information on	
13			exposures and potential confounders. Give information	
14			separately for exposed and unexposed groups if	
15			applicable.	
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23	Descriptive data	#14b	Indicate number of participants with missing data for	9
24			each variable of interest	
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29	Outcome data	#15	Report numbers of outcome events or summary	N/A- survey
30			measures. Give information separately for exposed and	design
31			unexposed groups if applicable.	
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36	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-	10
37			adjusted estimates and their precision (eg, 95%	
38			confidence interval). Make clear which confounders were	
39			adjusted for and why they were included	
40				
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46	Main results	#16b	Report category boundaries when continuous variables	10
47			were categorized	
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51	Main results	#16c	If relevant, consider translating estimates of relative risk	N/A no risk
52			into absolute risk for a meaningful time period	
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1	Other analyses	#17	Report other analyses done—e.g., analyses of	9, 12
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3			subgroups and interactions, and sensitivity analyses	
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6	Discussion			
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10	Key results	#18	Summarise key results with reference to study objectives	13-15
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13	Limitations	#19	Discuss limitations of the study, taking into account	15-16
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15			sources of potential bias or imprecision. Discuss both	
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17			direction and magnitude of any potential bias.	
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20	Interpretation	#20	Give a cautious overall interpretation considering	13-15
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22			objectives, limitations, multiplicity of analyses, results	
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24			from similar studies, and other relevant evidence.	
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28	Generalisability	#21	Discuss the generalisability (external validity) of the study	16
29				
30			results	
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33	Other Information			
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36	Funding	#22	Give the source of funding and the role of the funders for	16
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38			the present study and, if applicable, for the original study	
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40			on which the present article is based	
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Notes:

- 47 • 13c: N/A- Cross-sectional survey design
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- 50 • 15: N/A- survey design
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- 53 • 16c: N/A no risk The STROBE checklist is distributed under the terms of the Creative Commons
- 54 Attribution License CC-BY. This checklist was completed on 27. August 2020 using
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Assessing International Alcohol Consumption Patterns During Isolation from the COVID-19 Pandemic Using an Online Survey: Highlighting Negative Emotionality Mechanisms

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-044276.R1
Article Type:	Original research
Date Submitted by the Author:	20-Oct-2020
Complete List of Authors:	Sallie, Samantha; University of Cambridge, Psychiatry Ritou, Valentin; University of Paris, Faculty of Basic and Biomedical Sciences Bowden-Jones, Henrietta; University College London, Faculty of Brain Sciences; University of Cambridge, Psychiatry Voon, Valerie; Cambridge University, Psychiatry
Primary Subject Heading:	Mental health
Secondary Subject Heading:	Public health, Addiction
Keywords:	COVID-19, PSYCHIATRY, Substance misuse < PSYCHIATRY, PUBLIC HEALTH, Depression & mood disorders < PSYCHIATRY

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Assessing International Alcohol Consumption Patterns During Isolation from the COVID-19 Pandemic Using an Online Survey: Highlighting Negative Emotionality Mechanisms

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ABSTRACT

Objectives: The Coronavirus (COVID-19) pandemic has required drastic safety measures to control virus spread, including an extended self-isolation period. Stressful situations increase alcohol craving and consumption in Alcohol Use Disorder (AUD) and non-AUD drinkers. Thus, we assessed how COVID-19-related stress may have affected drinking behaviours in the general population.

Design: We developed an online cross-sectional survey, Habit Tracker (HabiT), which measured changes in drinking behaviours before and during COVID-19 quarantine. We also assessed psychiatric factors such as anxiety, depression (HADS), and impulsivity (SUPPS-P). Lastly, we related drinking behaviours to COVID-19-specific stress factors.

Setting: HabiT was released internationally, with individuals from 83 countries participating.

Participants: Participants were included if they were 18 years of age or older, and confirmed they were proficient in English. The survey was completed by 2,873 adults with 1,346 usable data (46.9% accurately completed).

Primary Outcome Measures: Primary outcome measures were change in amount and severity of drinking behaviours before and during quarantine, and current drinking severity during quarantine.

Results: Although drinking behaviors decreased overall during quarantine, 36% reported an increase in alcohol use. Those who increased alcohol use during quarantine were older individuals (CI: 0.04-0.1, $p < .0001$), essential workers (CI: -0.58- -0.1, $p = .01$), individuals with children (CI: -12.46-0.0, $p = .003$), those with a personal relationship with someone severely ill from COVID-19 (CI: -2- -0.38, $p = .01$), and those with higher depression (CI: 0.67-1.45, $p < .0001$), anxiety (CI: 0.61-1.5, $p = .0002$), and positive urgency impulsivity (CI: 0.16-0.72, $p = .009$). Further, country-level sub-sample analyses indicated that drinking amount (CI: 9.36-13.13, $p = .003$) increased in the United Kingdom during quarantine.

Conclusions: Our findings highlight a role for identifying those vulnerable for alcohol misuse during periods of self-isolation and underscore the theoretical mechanism of negative emotionality underlying drinking behaviours driven by stress. Limitations include a large degree of study dropout ($n = 1,515$). Future studies should assess the long-term effects of isolation on drinking behaviours.

Keywords: COVID-19; alcohol use; stress; depression; self-isolation

ARTICLE SUMMARY

Strengths and limitations of this study

- The HabiT study sampled drinking behaviours of a large, diverse population during the COVID-19 pandemic.
- Changes in drinking behaviours were assessed against specific COVID-19-related stress factors.
- Due to the length of the survey (8-10 minutes), we observed a large degree of study dropout.
- Subjects were within varying phases of lockdown during the time of testing.
- The prevalence of diagnosed Alcohol Use Disorder drinkers sampled was low, likely related to sampling issues or under-reporting.

INTRODUCTION

The Coronavirus (COVID-19) pandemic has necessitated drastic safety measures to control the virus spread. These measures included an extended self-isolation period in which individuals were permitted to leave their places of residence only to obtain amenities (e.g., food, medical care, toiletries, etc.) or engage in essential work. Individuals were not permitted face-to-face contact with anyone who did not reside within their immediate households. In the United Kingdom, these measures were instituted nationally on March 23rd, 2020, with a gradual lifting of restrictions on May 10th, 2020 ending on July 4th, 2020 with locality-specific intermittent reinstatement of these measures. Although a necessary precautionary measure to mitigate the devastating effects of COVID-19 on public health, evidence indicates that protracted periods of self-isolation, especially in the context of stress, may be related to acute and prolonged negative mental health consequences, particularly in individuals already struggling with psychiatric disorders.[1]

Indeed, current clinical reports from individuals in treatment for Substance Abuse Disorder indicate that the stress produced by COVID-19 social isolation measures have triggered greater and more frequent drug or alcohol cravings, subsequently leading to relapse.[2] This observation is relevant to a prominent mechanistic theory of negative emotionality underlying alcohol misuse.[3] The relationship between stress and alcohol consumption is widely recognised and can be observed in an experimental fashion.[4] In subjects with known Alcohol Use Disorder (AUD), stress and experimental manipulations of stress enhance the amount of alcohol consumed [5, 6], alcohol craving [7], problematic drinking behaviours, and likelihood of relapse.[8] Exposure to stress triggers relapse characterised by a re-instantiation of alcohol cravings and alcohol-seeking behaviours.

Increases in alcohol craving and consumption after stress exposure also occur in those without AUD. An increase in alcohol consumption is often used as a coping strategy for both chronic and specific stressful life events in both AUD and non-AUD drinkers.[9] Similarly in both groups, self-reported craving and subjective judgements of alcohol value rise following a stress task [10], and social drinkers consume more alcohol after witnessing a social stressor.[11] These relationships are moderated by gender [12], age [13], previous alcohol exposure [13], alcohol

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3 expectancies [14], and the pattern of alcohol consumption.[15] Further, psychiatric
4 symptomology such as anxiety and depression as well as pathological levels of personality traits
5 such as impulsivity are widely recognised predisposing factors to problematic alcohol use and
6 addiction.[3, 16]
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11 Thus, in response to these exceptional circumstances, we aimed to assess how social isolation
12 measures in the midst of the COVID-19 pandemic may have affected drinking behaviours in the
13 general adult population. We developed an international survey, entitled Habit Tracker (HabiT),
14 which evaluated drinking severity before (post-hoc recall) and during the COVID-19 quarantine
15 period. We hypothesised that changes in amount of alcohol consumption and severity of drinking
16 behaviours may be related to specific COVID-19 related stress factors, as well as demographic
17 and psychiatric factors. Further, we investigated if COVID-19-related stress factors influenced
18 changes in drinking amount, drinking severity, depression, and anxiety before and during
19 quarantine.
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28 **METHODS**

29 **Recruitment and inclusion criteria**

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31 The HabiT survey was a questionnaire that sought to assess the effects of isolation on alcohol,
32 smoking, and internet use. The effects on alcohol use are reported here. Subjects were included if
33 they were 18 years of age or older and confirmed they were proficient in reading and
34 understanding English. HabiT was advertised by University of Cambridge news page on May
35 11th, 2020, a day before its international release. For the next several days, the survey was
36 disseminated by news agencies throughout the United Kingdom (e.g., The Telegraph, BBC
37 Cambridgeshire, News Wise) as well as throughout various University of Cambridge colleges.
38 Further, the survey was posted and shared on personal and public social media sites (i.e.,
39 Facebook, Twitter). HabiT was approved by the Cambridge Psychology Research Ethics
40 Committee. All subjects gave informed consent and were not financially compensated for their
41 participation, although informed that- upon survey completion- they would be provided results of
42 the study through request. The data collected was fully anonymised. The survey was created
43 using Qualtrics (Provo, Utah) survey-building platform. Developed iteratively within-lab and
44 among co-authors to insure brevity and consistency, the average time to complete the survey was
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3 approximately 8-10 minutes, and all subjects could participate on either a computer or smart
4 phone device.
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8 **Patient and public involvement statement** 9

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11 We did not involve patients or the public in the research design, reporting, or survey
12 dissemination strategies of this study.
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16 **Demographic information** 17

18 The demographic information collected were as follows: age, gender, socioeconomic status,
19 intimate relationship status, country and city of residence, and any previous or current diagnosis
20 of a psychiatric or neurological disorder.
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26 **Attentional checks** 27

28 Every major section of the survey contained at least one question which served as an attentional
29 check to ensure subjects were correctly reading and answering survey questions to the best of
30 their ability. The attentional checks were structured to mirror the Likert scaling of each section
31 (e.g., “If you are reading this question, please select ‘Strongly Agree.’”).
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37 **Frequency and severity of alcohol consumption before and during the quarantine period** 38

39 We first asked subjects if they drank alcohol. If the answer was negative, they proceeded to the
40 next set of questions. If the answer was positive, we assessed the change in the amount and
41 severity of alcohol use as well as the current severity of alcohol use. We asked subjects to report
42 the following behaviours within a typical week in November (i.e. pre-quarantine) and within the
43 last week (i.e. during quarantine): (i) the number of units of alcohol consumed within the last
44 week with examples for the number of units for differing types of alcohol and sizes provided; (ii)
45 the change in severity using a time-scale adaptation of the first three questions of the Alcohol
46 Use Disorders Identification Test (AUDIT-C).[17] Subjects were asked to report how many days
47 in the last week they consumed an alcoholic beverage, how many drinks they consumed on a
48 typical day they were drinking in the last week, and how often they consumed six or more drinks
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3 on one occasion in the last week. To assess the current severity of drinking behaviours during
4 quarantine, we used a timescale-adapted version of the full AUDIT [18] which assessed problem
5 drinking behaviours within the last week such as an inability to stop drinking once started, failure
6 to perform responsibilities, feeling guilt or remorse, drinking shortly after waking to ease the
7 adverse physiological effects of drinking the night before, drinking to the point of memory loss,
8 injuring oneself or others due to drinking, and concern from a loved one or medical professional
9 related to the frequency or severity of one's drinking. We used two primary outcome measures:
10 the change in severity (AUDIT-C) corroborated with the secondary change in amount of
11 drinking (units per week) and current severity (full AUDIT).
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20 **COVID-19-related stress factors**

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22 We assessed 10 factors which may contribute to COVID-19-related stress using the following
23 questions:
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- 27 1. Have you been deemed an "essential worker" by your government?
- 28 2. Do you work for health care services specifically with individuals who have contracted
29 Coronavirus (COVID-19)? (Sub-question of question 1)
- 30 3. Has your employment situation changed due to the Coronavirus (COVID-19) crisis?
- 31 4. Has anyone you know personally contracted or have shown symptoms characteristic of
32 Coronavirus (COVID-19)?
- 33 5. Has anyone you know personally become severely ill or died due to contracting
34 Coronavirus (COVID-19)?
- 35 6. Are you isolated alone?
- 36 7. Do you have children?
- 37 8. If you have children, are you their only caretaker? (Sub-question of question 7)
- 38 9. If you are currently in isolation with others, how would you describe the quality of your
39 relations?
- 40 10. How often do you currently go outdoors (for work, essential duties, leisure, etc.)?
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Psychiatric measures

Depression and anxiety symptomology were measured using The Hospital Anxiety and Depression Scale (HADS); a brief, validated four-item questionnaire.[19] As a secondary analysis, we assessed impulsivity using the validated Short Impulsive-Behavior Scale (SUPPS-P).[20] This scale provides an overall impulsivity score, as well as five scores corresponding to impulsivity subscales: perseveration, lack of premeditation, sensation-seeking, negative urgency, and positive urgency.

Statistical analysis

Statistical analyses were performed using MATLAB (Version 2020a). All subjects who answered the attentional checks incorrectly (n=12), reported highly improbable answers regarding the units of alcohol they consumed weekly (e.g., 1,000 units), did not report their gender, or did not complete the psychiatric questionnaires were excluded from further analysis, leaving a total of 1346 subjects. Drinking severity scores of the sample were non-normally distributed (Shapiro-Wilk, $p < .05$), thus non-parametric tests were used.

We used Mann-Whitney U-tests to compare weekly alcohol unit consumption and alcohol severity before and during quarantine in the full group. Then, we divided subjects into three groups, those who during quarantine either increased, decreased, or did not change their alcohol consumption and performed a Kruskal-Wallis H-test to assess the relative drinking amount to severity indices of these groups.

We then assessed which COVID-19-related stress factors were associated with changes in either amount (alcohol units consumed per week), change in severity (AUDIT-C), current severity (full AUDIT), or current depression and anxiety using the following tests: 1) Mann-Whitney U-Tests to compare negative versus positive responses to the COVID-19 stress factors (MW), 2) MANCOVA [21] controlling for gender and age (MAN1), and 3) A second MANCOVA controlling for age, gender, depression, and anxiety symptomology (MAN2). For the MANCOVA tests, variables 'age,' 'depression severity,' and 'anxiety severity' were dichotomised via median split. For the COVID-19 stress primary factor comparisons (eight items), we used False Discovery Rate (FDR) to control for multiple comparisons with

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3 significance assigned at $p < .05$. [22, 23] Confidence intervals (CIs) are provided for significant
4 findings for the most stringent statistical test.
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8 On an exploratory basis, we then used Spearman's partial correlation to compare the drinking
9 severity indices of subjects who completed the timescale-adapted full AUDIT with SUPPS-P and
10 HADS scores to relate drinking severity of the overall sample to psychiatric measures. Lastly, in
11 order to assess possible directional relationships in changes in the severity of drinking behaviors
12 to depression, anxiety, and impulsivity; we performed Spearman's partial correlations with the
13 psychiatric questionnaires among the three aforementioned groups (i.e., increased, decreased,
14 and null). For both correlational analyses, we used FDR correction ($p < .05$) for multiple
15 comparisons.
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22 RESULTS

23 Demographic information

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25 A total of 2,873 subjects participated (data collection: 05/12/2020 to 05/28/2020) of which 1,346
26 had usable data based on defined criteria (1,515 dropouts; 46.9% accurately completed; please
27 refer to the supplementary materials for a demographic analysis of those who did not complete
28 the survey). Of these subjects, 859 (63.8%) reported that they drink alcohol (please refer to the
29 supplementary materials for demographic information for those report drinking alcohol). Of the
30 1346 subjects, the average age was 28.92 ± 10.45 years [CI: 28.2-29.53] (range= 18-90) with
31 more males (males: $n= 1006$; females: $n=325$; other: $n=15$) from 85 different countries of
32 residence, with the majority from the United Kingdom ($n= 434$) and the United States ($n= 355$),
33 followed by Canada ($n= 64$) and Germany ($n= 63$). Marital status was as follows: single: $n=785$;
34 married or committed: $n=571$; divorced or separated: $n=33$; widowed: $n=4$. Socioeconomic
35 status (as denoted by annual income) was as follows: <19.9k: $n=285$; 20-39.9k: $n= 273$; 20-
36 39.9k: $n=244$; 40-69.9k: $n=241$; 70-99.9k: $n=141$; >100k: $n=203$; and 232 subjects did not report
37 their incomes. Current psychiatric or neurological diagnoses were as follows: no diagnosis:
38 $n=1192$; depression: $n= 60$; anxiety: $n= 38$, Post-Traumatic Stress Disorder (PTSD): $n= 5$,
39 comorbid depression and anxiety: $n= 46$.
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Overall changes in drinking frequency and severity before and during quarantine

Of the total sample, the change in problem drinking severity (AUDIT-C) was in 0.89 ± 1.43 [CI: 0.81-0.96] (range: 0-8) and the mean change in the amount consumed was 5.62 ± 9.55 units per week [CI: 3.16-4.02] (range: 0-120). The current problem drinking severity (full AUDIT) was 3.14 ± 4.47 [CI: 2.9-3.37] (range: 0-32), with 557 subjects included that do not consume alcohol. Of the subjects who reported they consume alcohol ($n= 859$), the change in severity from pre-quarantine to quarantine was a decrease of 1.53 ± 1.6 , [CI: 5.01-5.64] range 0-8 ($U= 2.65$, [CI: 0-0.21] $p= .008$). The units of alcohol consumed per week was significantly decreased during the quarantine period (8.03 ± 14.22 units, [7.11-8.94] range= 1-120) compared to November (8.32 ± 11.92 units, [CI: 7.47-9.02] range = 0-150), $U= -2.29$, [CI: 0.0-0.0] $p= .02$ (Figure 1). However, in the UK, the units of alcohol consumed per week was significantly increased during the quarantine period (11.25 ± 17.73 units, [CI: 9.36-13.13] range= 1-120) compared to November (10.94 ± 14.17 units, [CI: 9.44-12.45] range = 0-150), $U= 3.0$, [CI: 0-0.7] $p= .003$. (For full country-level sub-analyses of change in weekly drinking amount, change in severity, and overall severity during quarantine, please refer to the supplementary materials). Of the international sample, 172 (20%) subjects reported abstinence from alcohol consumption during the quarantine period.. More subjects reported a decrease ($n= 384$, 45%) or an increase ($n= 308$, 36%) as opposed to no change ($n= 166$, 19%) of weekly alcohol consumption from November to the quarantine period ($X^2= 72.86$, $p= .001$; Figure 1).. Of the three groups, those who: 1) increased weekly units consumed during quarantine (7.5 ± 10.5 change in units, [CI: 6.33-8.7] range: 1-80), 2) decreased weekly units consumed during quarantine (-6.5 ± 9.5 change in units, [CI: -7.45- -5.55] range: -.2 - -120), and 3) did not change their weekly unit consumption, subjects who had increased the units of alcohol consumed during the quarantine period showed significantly higher current drinking severity scores (7.5 ± 5.6 , [CI: 6.89-8.15] range: 1-32) than those who reported decreases (3.5 ± 3.0 , [CI: 3.16-3.76] range: 1-21) or no changes (4.8 ± 3.6 , [CI: 4.17-5.23] range: 1-20) in weekly unit consumption ($H= 165.33$, [CI: 3.35-4.78] $p < .0001$, Figure 1).

[INSERT FIGURE 1 & FIGURE 1 LEGEND HERE]

COVID-19 stress factor evaluation

The change in amount of drinking was positively correlated with age ($r_s = 0.2$, [CI: 0.04-0.1] $p < .0001$), and gender with males (6.44 ± 10.8 units, [CI: 5.63-7.35] range: 0-120) showing an increased change in drinking amount relative to females (3.81 ± 5.18 , [CI: 3.08-4.32] range: 0-38) or other genders (1.32 ± 1.65 , [CI: 0.18-2.24] range: 0-5) ($H = 8.17$, $p = .003$). Changes in drinking severity were also related to both age and gender, with older individuals ($r_s = .2$, [CI: 0.01-0.02] $p < .0001$) and males (1.68 ± 1.74 , [CI: 1.55-1.83] range: 0-8) demonstrating greater changes in their drinking severity than females (1.16 ± 1.12 , [CI: 1.02-1.3] range: 0-8) and others (1.36 ± 1.29 , [CI: 0.54-2.18] range: 0-3) ($H = 6.02$, [CI: -0.81- -0.22] $p = .05$). (Gender-specific sub-analyses of drinking behaviours can be found in the supplementary materials). Thus, we utilised age and gender as covariates for both MANCOVA analyses. All relevant covariates used in these analyses were dichotomised via median split (age= 25.1 years, depression severity= 2, and anxiety severity= 1).

Primary COVID-19 stress factors

The influence of COVID-19 stress factors on the change in drinking severity, amounts consumed, and current drinking severity are reported in Tables 1, 2, and 3, respectively. Designated essential workers and those with children showed a greater increase in the amount consumed weekly and drinking severity as well as greater current severity. This remained significant including when controlled for demographic variables (age, gender) and psychiatric symptoms (depression, anxiety). Notably, although subjects with children reported an increase in the number of units of alcohol and severity of alcohol use, they also reported lower levels of depression and anxiety. Knowing an individual personally who was ill or severely ill with Covid-19 showed higher current alcohol drinking severity than those who did not, but with no change from pre- to post-quarantine. A reported change in employment status and isolating alone was associated with greater depression scores, with no differences in drinking behaviours. Isolating with others but reporting a poor relationship was associated with greater depression and anxiety, however, the lower drinking behaviours were moderated by age and gender effects. Finally, going outdoors was associated with greater current drinking severity and greater depression and anxiety scores controlling for all variables. Post-hoc tests confirmed that, in cases in which a significant relationship was lost between an item and either changes in drinking frequency or

severity due to controlling for age and gender (i.e., MANCOVA 1), age was the sole contributor (Essential worker: $F(1, 533.2) = 7$, [CI: 0.15-2.1] $p = .008$; Others ill: $F(1, 879.9) = 52.6$, [CI: 1.7-2.7] $p < .0001$; Poor relationship: $F(1, 933.9) = 48.88$, [CI: 1.8-2.8] $p < .0001$).

Stress Factor	N Total	Yes M(SD)	N Yes	No M(SD)	N No	MW p-value	MAN1 p-value	MAN2 p-value	CI
Essential worker	1337	0.16(1.9)	241	-0.21(1.6)	1096	0.02*	0.01*	0.01*	-0.58- -0.1
Employment	1337	-0.14(1.8)	323	-0.14(1.6)	1014	0.83	0.96	0.92	
Others ill	1334	-0.17(1.8)	497	-0.12(1.6)	837	0.75	0.64	0.63	
Others severely ill	1336	-0.01(2)	127	-0.15(1.6)	1209	0.35	0.7	0.69	
Isolated alone	1325	-0.1(1.9)	168	-0.15(1.6)	1157	0.83	0.85	0.82	
Having children	1334	0.34(1.4)	209	-0.23(1.7)	1125	<.0001*	0.005*	0.003*	-12.46-0.0
Poor relationship	1168	-0.3(1.7)	187	-0.13(1.6)	981	0.35	0.7	0.69	
Going outdoors	1336	-0.27(1.3)	193	-0.12(1.7)	1143	0.26	0.7	0.69	

Table 1. COVID-19 primary stress items relationship with changes in drinking severity (as indexed by the AUDIT-C) from pre-quarantine to quarantine.

Stress Factor	N Total	Yes M(SD)	N Yes	No M(SD)	N No	MW p-value	MAN1 p-value	MAN2 p-value	CI
Essential worker	1337	1.26(12.8)	241	0.45(7.5)	1096	0.0003*	0.07	0.08	-3.4- -0.02
Employment	1337	0.17(11.2)	323	0.13(7.8)	1014	0.77	0.95	0.97	
Others ill	1334	0.05(7.1)	497	0.2(9.6)	837	0.83	0.95	0.97	
Others severely ill	1336	0.06(7.6)	127	0.15(8.9)	1209	0.83	0.95	0.97	
Isolated alone	1325	0.05(11.6)	168	0.2(8.2)	1157	0.46	0.95	0.97	
Having children	1334	2.02(11.9)	209	0.54(7.9)	1125	<.0001*	0.04*	0.02*	-3.6- -0.74
Poor relationship	1168	0.4(6.1)	187	0.19(8.7)	981	0.46	0.95	0.97	
Going outdoors	1336	1.23(6.8)	193	0.04(9.0)	1143	0.15	0.47	0.4	

Table 2. COVID-19 primary stress items relationship with changes in drinking amount (in units) from pre-quarantine to quarantine.

Stress Factor	N Total	Severity Type	Yes M(SD)	N Yes	N M(SD)	N No	M-W p-value	MAN1 p-value	MAN2 p-value	CI
Essential worker	1337	Drinking	4.42(5.7)	243	2.85(4.1)	1099	<.0001*	0.0005*	0.0005*	-1.8- -0.57
		Depression	2.29(1.8)	243	2.44(1.9)	1099	0.43	0.84		
		Anxiety	1.79(1.7)	243	1.94(1.8)	1099	0.42	0.8		
Employment change	1337	Drinking	3.46(4.9)	324	3.02(4.3)	1018	0.38	0.08	0.144	
		Depression	2.78(2.0)	324	2.31(1.9)	1018	0.0043*	0.007*		-0.58- -0.1
		Anxiety	2.03(4.5)	324	1.88(1.8)	1018	0.32	0.363		
Others ill	1334	Drinking	3.59(1.9)	499	2.87(4.4)	840	<.0001*	0.1	0.125	-1.2- -0.2
		Depression	2.3(1.8)	499	2.47(1.9)	840	0.20	0.83		
		Anxiety	1.9(5.5)	499	1.93(1.9)	840	0.99	0.94		
Others severely ill	1336	Drinking	4.49(2.0)	127	2.99(4.3)	1214	0.001*	0.007*	0.01*	-2- -0.38
		Depression	2.45(2.0)	127	2.4(1.9)	1214	0.99	0.41		
		Anxiety	1.92(5.8)	127	1.91(1.8)	1214	0.82	0.84		
Isolated alone	1325	Drinking	3.88(2.0)	169	2.98(4.2)	1161	0.42	0.83	0.87	
		Depression	3.4(1.9)	169	2.41(1.9)	1161	0.009*	0.04*		-0.7- -0.06
		Anxiety	2.04(5.2)	169	1.9(1.8)	1161	0.43	0.11		

Having children	1334	Drinking	5.17(1.8)	211	2.75(4.2)	1128	< .0001*	0.0003*	<.0001*	-2.4- -0.9
		Depression	1.5(1.7)	211	2.58(1.9)	1128	<.0001*	<.0001*		0.37-0.97
		Anxiety	1.37(1.7)	211	2.02(1.9)	1128	<.0001*	0.0009*		0.25-0.85
Poor relationship	1168	Drinking	2.82(5.1)	187	3.1(4.1)	985	0.01*	0.92	0.87	0.4- 1.0
		Depression	3.57(2.0)	187	2.2(1.8)	985	<.0001*	<.0001*		-1.53- -1
		Anxiety	2.79(2.0)	187	1.74(1.8)	985	<.0001*	<.0001*		-1.3- -0.73
Going outdoors	1336	Drinking	3.42(4.5)	1148	1.37(3.4)	193	<.0001*	<.0001*	<.0001*	1.14-2.47
		Depression	3.18(2.0)	193	2.28(1.9)	1148	<.0001*	<.0001*		-1- -0.42
		Anxiety	2.42(2.0)	193	1.83(1.8)	1148	0.0002*	0.0008*		-0.8- -0.24

Table 3. COVID-19 primary stress items relationship with current drinking severity (i.e., full AUDIT), depression, and anxiety from pre-quarantine to quarantine.

Secondary COVID-19 stress factors

Two COVID-19 stress factors were considered secondary as they represented a subset of a primary factor. Working for health care services was associated with a trend towards a greater change in amount of units consumed ($F = 3.97$ [CI: -6.73- -0.0], $p = .05$) and greater severity of current drinking ($F = 7.01$, [CI: -3.9- -0.6] $p = .007$) when controlled for all variables. Being the only caretaker for children was also associated with greater change in drinking severity ($U = 2.62$, [CI: -2.7- -0.9] $p = .009$) and greater change of amount consumed ($U = 2.67$, [CI: -4.5- -0.8] $p = .007$), but was no longer significant when controlling for age and gender.

Drinking severity during quarantine and correlations with psychiatric measures

Of the individuals who reported drinking alcohol, ($n = 769$) completed the current drinking severity index (e.g., the adapted-timescale full AUDIT). The severity of drinking behaviours was positively related to depression ($r_s = .12$, [CI: 0.34-.79] $p = .004$), anxiety ($r_s = .12$, [CI: 0.3-0.74] $p = .027$), and positive urgency impulsivity ($r_s = .12$, [CI: 0.14-0.34] $p = .004$), controlled for age and gender. To assess potential directional relationships between current drinking severity during quarantine and psychiatric measures, we correlated depression, anxiety, and impulsivity with the three drinking groups (i.e., increased, decreased, null). Drinking severity scores in the decreased and no change groups were not significantly correlated with any of the psychiatric measures of interest. However, drinking severity of those who increased their units consumed during the quarantine period were related to depression ($r_s = .30$, [CI: 0.67-1.45] $p < .0001$), anxiety ($r_s = .23$, [CI: 0.61-1.5] $p = .0002$), and positive urgency ($r_s = .17$, [CI: 0.16-0.72] $p = .009$) (Figure 2).

[INSERT FIGURE 2 & FIGURE 2 LEGEND HERE]

DISCUSSION

We show an overall decrease in amounts and severity of problem alcohol use from pre-quarantine to the quarantine period. Critically, however, three different subpopulations were identified with most either increasing or decreasing use as compared to remaining unchanged in their alcohol use behaviours. Greater drinking was associated with demographic factors including age and male gender, COVID-19 stress-related factors, and psychiatric factors such as depression, anxiety, or the impulsivity subscale of positive urgency. Our findings underscore the theoretical mechanism of negative emotionality underlying drinking behaviours driven by stress, depression, and anxiety.

An overall decrease in alcohol use and problematic use may have multiple potential etiologies. Stringent lockdown may be associated with a decrease in the presence or availability of alcoholic beverages within the immediate household given limitations in access, a decrease in exposure to alcohol cues that may trigger urges, or the preference to consume alcohol within social contexts. More subjects reported either decreasing or increasing the frequency of their alcohol intake as compared to remaining unchanged, consistent with previous reports of a greater tendency toward extremes in individual drinking patterns when faced with either acute or chronic life stressors.[15]

Older individuals showed a greater increase in drinking behaviours during lockdown and current severity of problem drinking consistent with demographic factors known to be associated with alcohol misuse. Whether one increases their drinking after experiencing acute or chronic life stress is age-dependent, which may reflect a function of previous alcohol experience.[13] Age may play a particularly unique role in the context of COVID-19 due to the greater need for stringent isolation with age, potentially fewer supports, and the risk of greater isolation, loneliness, and concern about the impact of COVID-19 on one's personal health. Expectedly, males showed greater unit consumption compared to females and other genders overall. However, males showed a decrease in both drinking amount and severity during quarantine,

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3 while females demonstrated the opposite trend. This finding corroborates evidence which
4 indicates females are more likely than males to consume alcohol in order to cope with stress.[24]
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8 COVID-19 specific stress factors appear to influence drinking behaviours controlled for other
9 confounding variables. Being deemed an essential worker and having children was associated
10 with a greater increase in drinking behaviours during quarantine. Importantly, although having
11 children was associated with an increase in alcohol use, depression and anxiety scores were
12 lower than in those without children. This suggests the additional burden of childcare and home
13 schooling contributed to the tendency towards drinking possibly in the context of stress relief and
14 was not mediated by greater depression or anxiety symptoms. The presence of children may also
15 be protective against depressive and anxiety symptoms during lockdown. Having children may
16 mitigate against loneliness that has been highlighted as a major issue during the isolation of
17 lockdown.[25] A subset of the essential worker category – health care workers responsible for
18 taking care of individuals with COVID-19 – was associated with greater severity of problem
19 drinking behaviours. Thus, the specific impact of lockdown on the necessity for essential
20 workers and the impact of the burden of home schooling and childcare on parents appears to
21 enhance drinking behaviours independent of an impact on psychiatric symptomatology.
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35 As expected, having a personal relationship with someone who had become severely ill or died
36 due to COVID-19 was associated with a greater increase in severity of problem drinking
37 behaviours. Going outdoors more frequently for work, exercise, or essential duties during
38 lockdown was similarly associated with greater severity of alcohol use, as well as depressive and
39 anxiety symptoms. The reasons behind the need to go outdoors complicate the interpretation, as
40 it might be confounded by being an essential worker but also allow for greater access to the
41 purchase of alcohol. Living with others but having a poor quality of relationship was
42 unexpectedly associated with a lower drinking severity but with greater depressive and anxiety
43 symptoms. Living alone was not associated with any changes in drinking behaviours but was
44 associated with greater depressive symptomatology. These findings might support the role of
45 drinking in the context of social interactions; and further highlight the importance of social
46 interactions during lockdown, the role of loneliness, and its impact on mental health.[25]
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3 Importantly, those residing in the UK- unlike those in the US and Canada- displayed an increase
4 in weekly alcohol units consumed during quarantine, consistent with the WHO Global Status
5 Report on Alcohol and Health (2018) which shows that total alcohol per capita consumption
6 (APC) is higher in the UK than in the US or Canada.[26]
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11 We further observed a relationship between the current severity of drinking behaviours and
12 psychiatric symptoms such as depression, anxiety or positive urgency. These relationships were
13 driven particularly by the group which increased their drinking during quarantine. That both
14 negative and positive emotionality factors are associated with increased drinking behaviours is in
15 keeping with the multiple paths towards alcohol use. The effects of depression and anxiety on
16 alcohol consumption in both AUD and non-AUD drinkers are well-documented [27-30] and
17 related to mechanistic theories of negative emotionality, which suggest that individuals may
18 increase their alcohol consumption in stressful contexts to cope with aversive emotional
19 states.[31] Positive emotional factors appear to also play a role in the association with positive
20 urgency, a subtype of impulsivity characterised by the propensity to engage in disinhibited
21 behaviors including alcohol consumption when experiencing an intensified hedonic or excited
22 state.[30] Positive affect-based impulsivity may reflect a heightened reward sensitivity
23 associated with problem drinking behaviours.[32]
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37 **Limitations and future directions**

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39 This study is not without limitations. HabiT is a cross-sectional, retrospective survey and hence
40 potentially limited by recall and misclassification biases as well as lack of longitudinal follow-
41 up. Because retrospective reporting involves issues with memory, possible Dunning-Kruger
42 effects, and selection bias; the reader should be cautious in drawing causal interpretations from
43 the current data. Because the aim of the HabiT study was to investigate changes in frequency and
44 severity of drinking behaviour in a large, wider population, we issued the survey internationally
45 and during a later period of enforced isolation. Thus, the possibility cannot be overlooked that
46 subjects were within varying phases of lockdown characterised by differential restrictions during
47 the time of testing which may have influenced our current results. Future studies may consider
48 data analysis by country, level of lockdown, or amount and severity of localised COVID-19
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3 cases. Also, approximately half of the individuals who began the survey did not complete it. This
4 may be due to the length of the survey (i.e., 8-10 minutes). Prospective studies using an online
5 survey design should further condense questionnaires and/or offer subjects monetary incentives
6 obtained upon survey completion in order to attenuate dropout and non-response bias. The
7 current HabiT survey only assessed the *acute* effects of COVID-19 isolation measures on
8 changes in drinking behaviours in comparison to the pre-quarantine period. Hence, follow-up
9 studies should be employed during the immediate post-quarantine period to investigate the
10 possible protracted effects of COVID-19 isolation on drinking behaviours. Furthermore, whether
11 the sampling adequately reflects the population distribution in the form of sampling bias may be
12 an issue with online questionnaires and may under-represent those who do not have smartphones
13 or access to the internet [33], have limited facility with online questionnaires (e.g., older
14 individuals) [33], were otherwise engaged (e.g., caring for an ill individual or children), or are
15 more severely ill with substance use or other mental health disorders. Thus, our ability to
16 generalise our current findings to the wider population is limited. Other methods (e.g., phone
17 surveys) are recommended to reach populations under-represented by online surveys.[34] As few
18 respondents reported a previous history of alcohol problems relative to the expected prevalence
19 rates, the reporting is likely either a function of sampling bias, limited willingness to reveal such
20 a history in an online survey, or marked changes in alcohol use particularly if relapse occurs.
21 This limits our capacity to assess the change in drinking behaviours in those with a history of
22 alcohol problems. Further studies focusing specifically on the newly abstinent or those with a
23 history of alcohol problems are indicated.

41 42 **CONCLUSION**

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44 Although alcohol drinking behaviours appeared to decrease overall during lockdown, we
45 emphasise that specific groups may be at higher risk for developing problematic alcohol use
46 behaviours. In particular, factors associated with an increase in alcohol use include older
47 individuals, essential workers, parents with children, those with a personal relationship with
48 someone severely ill from COVID-19, and those with higher depression, anxiety levels, or
49 positive urgency impulsivity. Further, unlike residents from the US and Canada, those in the UK
50 increased their weekly alcohol intake during the quarantine period. We emphasise that those with
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3 a previous history of alcohol misuse or a family history of AUD were not the specific focus of
4 this study and may represent a high risk group which requires further investigation. Alcohol can
5 be used in brief, moderate amounts in a healthy, non-pathological manner related to socialisation
6 and stress relief. However, a subgroup of these individuals may still be at higher risk for longer
7 term issues with alcohol misuse. The lockdown resulted in a unique set of stressors that in some
8 cases may persist (e.g. childcare, grieving, prolonged depression or anxiety related to the
9 lockdown) and might again re-emerge with the imposition of localised lockdowns or further
10 lockdowns in the context of a second wave. Further studies on the longitudinal impact and
11 persistence of these behaviours are critical. Our findings highlight a need for identifying those at
12 greater risk for alcohol misuse to aim for greater support services and proactively target mental
13 health issues associated with problem drinking behaviours such as depression or anxiety.
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30 potential conflicts of interest.
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34 **Author Contributions:** SS created the HabiT survey, collaborated with VR in analysing the
35 collected data, and drafted and edited the manuscript. VR coded and analysed the data. HBJ
36 collaborated with VV in conceptualising the study. VV conceptualised the study, gave crucial
37 guidance in creating the HabiT survey, and edited the manuscript.
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43 **Data Statement:** All participant data used in this research is deidentified. Participant data and
44 MATLAB statistical code used for analysis is available upon reasonable request from
45 corresponding author, Samantha N. Sallie, at habittstudy2020@gmail.com.
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LEGENDS FOR FIGURES

Figure 1. Changes in amount and severity of drinking behaviours in the HabiT sample between pre-quarantine and quarantine periods. Units of alcohol consumed weekly (top left) and changes in drinking severity (AUDIT-C) (bottom right) decreased during the quarantine period and more individuals either increased or decreased their weekly units consumed during quarantine than remained the same (top right). Further, those who increased their weekly alcohol unit consumption during the quarantine period had significantly higher drinking severity indices (full AUDIT) compared to those who decreased or did not change their drinking behaviours during the quarantine period (bottom left).

Figure 2. Regression plots of the significant relationships between drinking severity and psychiatric measures in subjects who increased weekly alcohol unit consumption during quarantine. Drinking severity indices of the group who increased their drinking during the quarantine period were significantly positively related to depression severity, anxiety severity, and positive urgency (impulsivity subset).

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SUPPLEMENTARY MATERIALS

Demographics for drinkers

	Age		Sex		Country		SES		Relationship
Mean	31.4	Male	599	Total	49	Lower	328	Single	449
SD	13.2	Female	248	UK	347	Mid	176	Relationship	408
Range	18-90	Other	12	US	223	Higher	250		
	Depression		Anxiety		PTSD		Depression & Anxiety		
	41		27		3		35		

Demographic analysis for study dropouts

Although a majority of the dropout subjects (n=1,515) who entered the study provided no data (n=981), we performed a demographic analysis on dropout subjects who provided this information (n=481) to assess if those who completed the survey differed in demographic factors from those who did not. The mean age of dropout subjects was 26.58 ± 11.11 years [CI: 25.59-27.58] (range= 18-80 years), significantly younger than the mean of age of individuals who completed the survey ($U = 3.69$, [CI: 1.15-3.54] $p < .0001$). Further, more males (n=387) than females (n=87) or other genders (n=7) dropped out of the study prior to completion ($X^2 = 61.23$, $p < .0001$).

Sub-sample analysis by country

United Kingdom (UK)

In the UK, the change in problem drinking severity (AUDIT-C) was 1.05 ± 1.46 [CI: 0.91-1.19] (range: 0-8), and the mean change in the amount consumed was 5.93 ± 11.75 [CI: 4.82-7.05], units per week (range: 0-120). Current problem drinking severity (full AUDIT) was 4.09 ± 4.94 [CI: 3.62-4.56] (range: 0-27). Of the subjects who reported they consume alcohol (n=434), the change in severity from pre-quarantine to quarantine was a decrease of -0.16 ± 2.15 , [CI: -0.3-0.06] (range -8-6) but not significantly so ($U = -1.38$, [CI: 0.01-0.89] $p = .19$). The units of

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3 alcohol consumed per week was significantly increased during the quarantine period ($11.25 \pm$
4 17.73 units, [CI: 9.36-13.13] range= 1-120) compared to November (10.94 ± 14.17 units, [CI:
5 $9.44-12.45$] range = 0-150), $U= 3.0$, [CI: 0-0.7] $p= .003$. Further, 60 (14%) subjects reported
6 abstention from alcohol consumption during the quarantine period. More subjects reported a
7 decrease (n= 151, 43%) or an increase (n= 130, 39%) as opposed to no change (n= 61, 18%) of
8 weekly alcohol consumption from November to the quarantine period ($X^2= 7.2$, $p = .007$).
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14 United States (US)

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17 In the US, change in problem drinking severity (AUDIT-C) was 1.01 ± 1.55 units [CI: 0.85-1.17]
18 (range: 0-8), and the mean change in the amount consumed was 3 ± 5.51 [CI: 2.39-4] units per
19 week (range: 0-34). The current problem drinking severity (full AUDIT) was 3.48 ± 4.95 [CI: 3-
20 4] (range: 0-32). Of the subjects who reported they consume alcohol (n= 353), the change in
21 severity from pre-quarantine to quarantine was a decrease of -0.11 ± 2.42 [CI: -0.43-0.21], range
22 -8-8 ($U= -0.66$, [CI: 0.05-0.9] $p= .51$), but not significantly so. The units of alcohol consumed
23 per week increased between the quarantine period (7.39 ± 11.45 units, [CI: 5.88-8.9] range= 0-
24 80) and November (6.93 ± 9.78 units, [CI: 5.88-8.9] range = 0-96), but not significantly so ($U= -$
25 1.1 , [CI: 0.01-0.94] $p= .29$). Further, 44 (13%) subjects reported abstention from alcohol
26 consumption during the quarantine period. More subjects reported a decrease (n= 90, 41%) or an
27 increase (n= 88, 40%) as opposed to no change (n= 45, 21%) of weekly alcohol consumption
28 from November to the quarantine period ($X^2= 8.15$, $p = .004$).
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39 Canada

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42 In Canada, change in problem drinking severity (AUDIT-C) was 0.67 ± 1.45 [CI: 0.31-1.03]
43 (range: 0-8), and the mean change in the amount consumed was 3.03 ± 7.45 [CI: 1.17-4.89] units
44 per week (range: 0-49). The current problem drinking severity (full AUDIT) was 2.78 ± 4.24
45 [CI: 1.7-3.85] (range: 0-24). Of the subjects who reported they consume alcohol (n= 35), the
46 change in severity from pre-quarantine to quarantine was an increase of 0.16 ± 2.2 , [CI: -0.62-
47 0.95](range= -8-5), but not significantly so ($U= .77$, [CI: 0.03-0.98] $p= .44$). The units of alcohol
48 consumed per week was decreased during the quarantine period (8.03 ± 14.22 units, [CI:]
49 range= 0-50) and November (6.71 ± 9.49 units, [CI: 3.46-9.97] range = 0-25), although not
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3 significantly so ($U = 0.17$, [CI: 0.59-1.0] $p = .86$). Further, 4 (12%) subjects reported abstinence
4 from alcohol consumption during the quarantine period. More subjects reported an increase ($n =$
5 16, 46%) as opposed to a decrease ($n = 10$, 29%) or no change ($n = 9$, 26%) of weekly alcohol
6 consumption from November to the quarantine period, although not significantly so ($X^2 = 0.03$,
7 $p = .85$).
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13 **Sub-sample analysis by gender**

16 Males

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20 For the males in our sample ($n = 1,000$), the change in problem drinking severity (AUDIT-C) was
21 in 0.91 ± 1.53 [CI: 0.82-1.01] (range: 0-8) and the mean change in the amount consumed was
22 3.88 ± 8.84 [CI: 3.33-4.42] units per week (range: 0-120). The current problem drinking severity
23 (full AUDIT) was 2.99 ± 4.61 [CI: 2.71-3.28] (range: 0-32), with 403 males included that do not
24 consume alcohol. Of males who reported they consume alcohol ($n = 597$), the change in severity
25 from pre-quarantine to quarantine was a decrease of -0.4 ± 2.4 , [CI: -0.5- -0.21] range -8-8 ($U = -$
26 3.57 , [CI: 0.0-0.03] $p < .0001$). The units of alcohol consumed per week was significantly
27 decreased during the quarantine period (8.52 ± 14 units, [CI: 7.33-9.71] range = 0-120) compared
28 to November (9.23 ± 12.62 units, [CI: 8.21-10.24] range = 0-120), $U = -5.2$, [CI: 0.0-0.13] $p <$
29 $.0001$. Further, 128 (20%) males reported abstinence from alcohol consumption during the
30 quarantine period. More males reported a decrease ($n = 278$, 47%) or an increase ($n = 204$, 34%)
31 as opposed to no change ($n = 115$, 19%) of weekly alcohol consumption from November to the
32 quarantine period ($X^2 = 15.94$, $p < .0001$).
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43 Females

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46 For females in our sample ($n = 342$), the change in problem drinking severity (AUDIT-C) was
47 0.81 ± 1.1 [CI: 0.69-0.92] (range: 0-8) and the mean change in the amount consumed was $2.82 \pm$
48 4.6 [CI: 2.31-3.32] units per week (range: 0-38). The current problem drinking severity (full
49 AUDIT) was 3.14 ± 4.47 [CI: 3.13-4] (range: 0-21), with 95 females included that do not
50 consume alcohol. Of females who reported they consume alcohol ($n = 247$), the change in
51 severity from pre-quarantine to quarantine was an increase of 0.12 ± 1.6 , [CI: -0.08-0.32] range -
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3 5-8, although not significantly so ($U= 1.17$, [CI: 0.01-0.93] $p= .24$). The units of alcohol
4 consumed per week was decreased during the quarantine period (6.94 ± 10.62 units, [CI:]
5 range= 0-80) compared to November (6.01 ± 8.08 units, [CI: 5-7.02] range = 0-90), although not
6 significantly so ($U= -0.57$, [CI: 0.1-0.99] $p= .57$). Further, 43 (17%) females reported abstinence
7 from alcohol consumption during the quarantine period. More females reported a decrease ($n=$
8 102, 41%) or an increase ($n= 101$, 41%) as opposed to no change ($n= 44$, 18%) of weekly
9 alcohol consumption from November to the quarantine period ($X^2= 13.46$, $p = .0002$).
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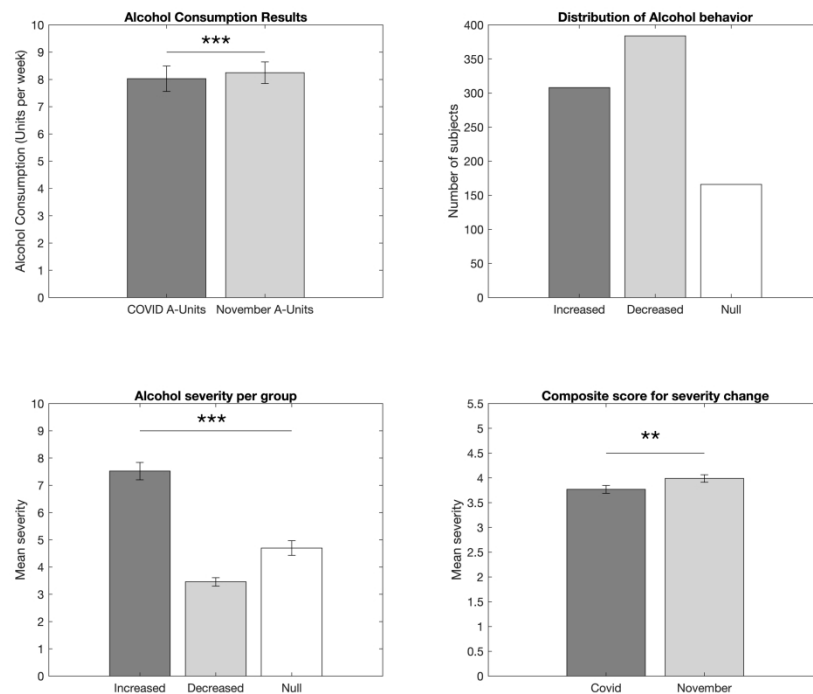


Figure 1. Changes in amount and severity of drinking behaviours in the HabiT sample between pre-quarantine and quarantine periods. Units of alcohol consumed weekly (top left) and changes in drinking severity (AUDIT-C) (bottom right) decreased during the quarantine period and more individuals either increased or decreased their weekly units consumed during quarantine than remained the same (top right). Further, those who increased their weekly alcohol unit consumption during the quarantine period had significantly higher drinking severity indices (full AUDIT) compared to those who decreased or did not change their drinking behaviours during the quarantine period (bottom left).

299x238mm (300 x 300 DPI)

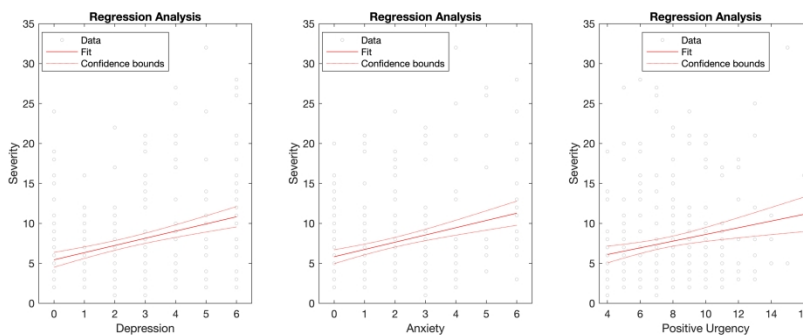


Figure 2. Regression plots of the significant relationships between drinking severity and psychiatric measures in subjects who increased weekly alcohol unit consumption during quarantine. Drinking severity indices of the group who increased their drinking during the quarantine period were significantly positively related to depression severity, anxiety severity, and positive urgency (impulsivity subset).

333x114mm (300 x 300 DPI)

SUPPLEMENTARY MATERIALS

Demographics for drinkers

	Age		Sex		Country		SES		Relationship
Mean	31.4	Male	599	Total	49	Lower	328	Single	449
SD	13.2	Female	248	UK	347	Mid	176	Relationship	408
Range	18-90	Other	12	US	223	Higher	250		
	Depression		Anxiety		PTSD		Depression & Anxiety		
	41		27		3		35		

Demographic analysis for study dropouts

Although a majority of the dropout subjects (n=1,515) who entered the study provided no data (n=981), we performed a demographic analysis on dropout subjects who provided this information (n=481) to assess if those who completed the survey differed in demographic factors from those who did not. The mean age of dropout subjects was 26.58 ± 11.11 years [CI: 25.59-27.58] (range= 18-80 years), significantly younger than the mean of age of individuals who completed the survey ($U= 3.69$, [CI: 1.15-3.54] $p < .0001$). Further, more males (n=387) than females (n=87) or other genders (n=7) dropped out of the study prior to completion ($X^2= 61.23$, $p < .0001$).

Sub-sample analysis by country

United Kingdom (UK)

In the UK, the change in problem drinking severity (AUDIT-C) was 1.05 ± 1.46 [CI: 0.91-1.19] (range: 0-8), and the mean change in the amount consumed was 5.93 ± 11.75 [CI: 4.82-7.05], units per week (range: 0-120). Current problem drinking severity (full AUDIT) was 4.09 ± 4.94 [CI: 3.62-4.56] (range: 0-27). Of the subjects who reported they consume alcohol (n=434), the change in severity from pre-quarantine to quarantine was a decrease of -0.16 ± 2.15 , [CI: -0.3-0.06] (range -8-6) but not significantly so ($U= -1.38$, [CI: 0.01-0.89] $p= .19$). The units of

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3 alcohol consumed per week was significantly increased during the quarantine period ($11.25 \pm$
4 17.73 units, [CI: 9.36-13.13] range= 1-120) compared to November (10.94 ± 14.17 units, [CI:
5 9.44 - 12.45] range = 0-150), $U= 3.0$, [CI: 0-0.7] $p= .003$. Further, 60 (14%) subjects reported
6 abstention from alcohol consumption during the quarantine period. More subjects reported a
7 decrease (n= 151, 43%) or an increase (n= 130, 39%) as opposed to no change (n= 61, 18%) of
8 weekly alcohol consumption from November to the quarantine period ($X^2= 7.2$, $p = .007$).
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14 United States (US)

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17 In the US, change in problem drinking severity (AUDIT-C) was 1.01 ± 1.55 units [CI: 0.85-1.17]
18 (range: 0-8), and the mean change in the amount consumed was 3 ± 5.51 [CI: 2.39-4] units per
19 week (range: 0-34). The current problem drinking severity (full AUDIT) was 3.48 ± 4.95 [CI: 3-
20 4] (range: 0-32). Of the subjects who reported they consume alcohol (n= 353), the change in
21 severity from pre-quarantine to quarantine was a decrease of -0.11 ± 2.42 [CI: -0.43-0.21], range
22 -8-8 ($U= -0.66$, [CI: 0.05-0.9] $p= .51$), but not significantly so. The units of alcohol consumed
23 per week increased between the quarantine period (7.39 ± 11.45 units, [CI: 5.88-8.9] range= 0-
24 80) and November (6.93 ± 9.78 units, [CI: 5.88-8.9] range = 0-96), but not significantly so ($U= -$
25 1.1 , [CI: 0.01-0.94] $p= .29$). Further, 44 (13%) subjects reported abstention from alcohol
26 consumption during the quarantine period. More subjects reported a decrease (n= 90, 41%) or an
27 increase (n= 88, 40%) as opposed to no change (n= 45, 21%) of weekly alcohol consumption
28 from November to the quarantine period ($X^2= 8.15$, $p = .004$).
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39 Canada

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42 In Canada, change in problem drinking severity (AUDIT-C) was 0.67 ± 1.45 [CI: 0.31-1.03]
43 (range: 0-8), and the mean change in the amount consumed was 3.03 ± 7.45 [CI: 1.17-4.89] units
44 per week (range: 0-49). The current problem drinking severity (full AUDIT) was 2.78 ± 4.24
45 [CI: 1.7-3.85] (range: 0-24). Of the subjects who reported they consume alcohol (n= 35), the
46 change in severity from pre-quarantine to quarantine was an increase of 0.16 ± 2.2 , [CI: -0.62-
47 0.95](range= -8-5), but not significantly so ($U= .77$, [CI: 0.03-0.98] $p= .44$). The units of alcohol
48 consumed per week was decreased during the quarantine period (8.03 ± 14.22 units, [CI:]
49 range= 0-50) and November (6.71 ± 9.49 units, [CI: 3.46-9.97] range = 0-25), although not
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3 significantly so ($U = 0.17$, [CI: 0.59-1.0] $p = .86$). Further, 4 (12%) subjects reported abstinence
4 from alcohol consumption during the quarantine period. More subjects reported an increase ($n =$
5 16, 46%) as opposed to a decrease ($n = 10$, 29%) or no change ($n = 9$, 26%) of weekly alcohol
6 consumption from November to the quarantine period, although not significantly so ($X^2 = 0.03$,
7 $p = .85$).
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10 11 12 **Sub-sample analysis by gender**

13 14 15 **Males**

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20 For the males in our sample ($n = 1,000$), the change in problem drinking severity (AUDIT-C) was
21 in 0.91 ± 1.53 [CI: 0.82-1.01] (range: 0-8) and the mean change in the amount consumed was
22 3.88 ± 8.84 [CI: 3.33-4.42] units per week (range: 0-120). The current problem drinking severity
23 (full AUDIT) was 2.99 ± 4.61 [CI: 2.71-3.28] (range: 0-32), with 403 males included that do not
24 consume alcohol. Of males who reported they consume alcohol ($n = 597$), the change in severity
25 from pre-quarantine to quarantine was a decrease of -0.4 ± 2.4 , [CI: -0.5- -0.21] range -8-8 ($U = -$
26 3.57 , [CI: 0.0-0.03] $p < .0001$). The units of alcohol consumed per week was significantly
27 decreased during the quarantine period (8.52 ± 14 units, [CI: 7.33-9.71] range = 0-120) compared
28 to November (9.23 ± 12.62 units, [CI: 8.21-10.24] range = 0-120), $U = -5.2$, [CI: 0.0-0.13] $p <$
29 $.0001$. Further, 128 (20%) males reported abstinence from alcohol consumption during the
30 quarantine period. More males reported a decrease ($n = 278$, 47%) or an increase ($n = 204$, 34%)
31 as opposed to no change ($n = 115$, 19%) of weekly alcohol consumption from November to the
32 quarantine period ($X^2 = 15.94$, $p < .0001$).
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43 44 45 **Females**

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47 For females in our sample ($n = 342$), the change in problem drinking severity (AUDIT-C) was
48 0.81 ± 1.1 [CI: 0.69-0.92] (range: 0-8) and the mean change in the amount consumed was $2.82 \pm$
49 4.6 [CI: 2.31-3.32] units per week (range: 0-38). The current problem drinking severity (full
50 AUDIT) was 3.14 ± 4.47 [CI: 3.13-4] (range: 0-21), with 95 females included that do not
51 consume alcohol. Of females who reported they consume alcohol ($n = 247$), the change in
52 severity from pre-quarantine to quarantine was an increase of 0.12 ± 1.6 , [CI: -0.08-0.32] range -
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3 5-8, although not significantly so ($U= 1.17$, [CI: 0.01-0.93] $p= .24$). The units of alcohol
4 consumed per week was decreased during the quarantine period (6.94 ± 10.62 units, [CI:]
5 range= 0-80) compared to November (6.01 ± 8.08 units, [CI: 5-7.02] range = 0-90), although not
6 significantly so ($U= -0.57$, [CI: 0.1-0.99] $p= .57$). Further, 43 (17%) females reported abstinence
7 from alcohol consumption during the quarantine period. More females reported a decrease ($n=$
8 102, 41%) or an increase ($n= 101$, 41%) as opposed to no change ($n= 44$, 18%) of weekly
9 alcohol consumption from November to the quarantine period ($X^2= 13.46$, $p = .0002$).
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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Page
	Reporting Item	Number
Title and abstract		
Title	#1a Indicate the study's design with a commonly used term in the title or the abstract	1

1	Abstract	#1b	Provide in the abstract an informative and balanced	2
2				
3				
4			summary of what was done and what was found	
5				
6	Introduction			
7				
8				
9				
10	Background /	#2	Explain the scientific background and rationale for the	4
11				
12	rationale		investigation being reported	
13				
14				
15	Objectives	#3	State specific objectives, including any prespecified	5
16				
17			hypotheses	
18				
19				
20	Methods			
21				
22				
23	Study design	#4	Present key elements of study design early in the paper	5
24				
25				
26	Setting	#5	Describe the setting, locations, and relevant dates,	5
27				
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29			including periods of recruitment, exposure, follow-up, and	
30				
31			data collection	
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33				
34	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods	5
35				
36			of selection of participants.	
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40		#7	Clearly define all outcomes, exposures, predictors,	6-7
41				
42			potential confounders, and effect modifiers. Give	
43				
44			diagnostic criteria, if applicable	
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47	Data sources /	#8	For each variable of interest give sources of data and	6-7
48				
49	measurement		details of methods of assessment (measurement).	
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52			Describe comparability of assessment methods if there is	
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54			more than one group. Give information separately for for	
55				
56			exposed and unexposed groups if applicable.	
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1	Bias	#9	Describe any efforts to address potential sources of bias	7-8
2				
3				
4	Study size	#10	Explain how the study size was arrived at	7-8
5				
6				
7	Quantitative	#11	Explain how quantitative variables were handled in the	8
8	variables		analyses. If applicable, describe which groupings were	
9			chosen, and why	
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15	Statistical	#12a	Describe all statistical methods, including those used to	8
16	methods		control for confounding	
17				
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20	Statistical	#12b	Describe any methods used to examine subgroups and	8
21	methods		interactions	
22				
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25				
26	Statistical	#12c	Explain how missing data were addressed	7-8
27	methods			
28				
29				
30				
31	Statistical	#12d	If applicable, describe analytical methods taking account	N/A
32	methods		of sampling strategy	
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34				
35				
36	Statistical	#12e	Describe any sensitivity analyses	8
37	methods			
38				
39				
40				
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42	Results			
43				
44				
45	Participants	#13a	Report numbers of individuals at each stage of study—eg	9
46			numbers potentially eligible, examined for eligibility,	
47			confirmed eligible, included in the study, completing	
48			follow-up, and analysed. Give information separately for	
49			for exposed and unexposed groups if applicable.	
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57	Participants	#13b	Give reasons for non-participation at each stage	8
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1	Participants	#13c	Consider use of a flow diagram	N/A- Cross-
2				sectional
3				survey
4				design
5				
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11	Descriptive data	#14a	Give characteristics of study participants (eg	9
12			demographic, clinical, social) and information on	
13			exposures and potential confounders. Give information	
14			separately for exposed and unexposed groups if	
15			applicable.	
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23	Descriptive data	#14b	Indicate number of participants with missing data for	9
24			each variable of interest	
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29	Outcome data	#15	Report numbers of outcome events or summary	N/A- survey
30			measures. Give information separately for exposed and	design
31			unexposed groups if applicable.	
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36	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-	10
37			adjusted estimates and their precision (eg, 95%	
38			confidence interval). Make clear which confounders were	
39			adjusted for and why they were included	
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46	Main results	#16b	Report category boundaries when continuous variables	10
47			were categorized	
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51	Main results	#16c	If relevant, consider translating estimates of relative risk	N/A no risk
52			into absolute risk for a meaningful time period	
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1	Other analyses	#17	Report other analyses done—e.g., analyses of	9, 12
2				
3			subgroups and interactions, and sensitivity analyses	
4				
5				
6	Discussion			
7				
8				
9				
10	Key results	#18	Summarise key results with reference to study objectives	13-15
11				
12				
13	Limitations	#19	Discuss limitations of the study, taking into account	15-16
14				
15			sources of potential bias or imprecision. Discuss both	
16				
17			direction and magnitude of any potential bias.	
18				
19				
20	Interpretation	#20	Give a cautious overall interpretation considering	13-15
21				
22			objectives, limitations, multiplicity of analyses, results	
23				
24			from similar studies, and other relevant evidence.	
25				
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28	Generalisability	#21	Discuss the generalisability (external validity) of the study	16
29				
30			results	
31				
32				
33	Other Information			
34				
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36	Funding	#22	Give the source of funding and the role of the funders for	16
37				
38			the present study and, if applicable, for the original study	
39				
40			on which the present article is based	
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Notes:

- 13c: N/A- Cross-sectional survey design
- 15: N/A- survey design
- 16c: N/A no risk The STROBE checklist is distributed under the terms of the Creative Commons Attribution License CC-BY. This checklist was completed on 27. August 2020 using

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3 [Penelope.ai](#)
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Assessing International Alcohol Consumption Patterns During Isolation from the COVID-19 Pandemic Using an Online Survey: Highlighting Negative Emotionality Mechanisms

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Secondary Subject Heading:	Public health, Addiction
Keywords:	COVID-19, PSYCHIATRY, Substance misuse < PSYCHIATRY, PUBLIC HEALTH, Depression & mood disorders < PSYCHIATRY

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Assessing International Alcohol Consumption Patterns During Isolation from the COVID-19 Pandemic Using an Online Survey: Highlighting Negative Emotionality Mechanisms

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Word Count: 4,618

ABSTRACT

Objectives: The Coronavirus (COVID-19) pandemic has required drastic safety measures to control virus spread, including an extended self-isolation period. Stressful situations increase alcohol craving and consumption in Alcohol Use Disorder (AUD) and non-AUD drinkers. Thus, we assessed how COVID-19-related stress may have affected drinking behaviours in the general population.

Design: We developed an online cross-sectional survey, Habit Tracker (HabiT), which measured changes in drinking behaviours before and during COVID-19 quarantine. We also assessed psychiatric factors such as anxiety, depression (HADS), and impulsivity (SUPPS-P). Lastly, we related drinking behaviours to COVID-19-specific stress factors.

Setting: HabiT was released internationally, with individuals from 83 countries participating.

Participants: Participants were included if they were 18 years of age or older, and confirmed they were proficient in English. The survey was completed by 2,873 adults with 1,346 usable data (46.9% accurately completed).

Primary Outcome Measures: Primary outcome measures were change in amount and severity of drinking behaviours before and during quarantine, and current drinking severity during quarantine.

Results: Although drinking behaviors decreased overall during quarantine, 36% reported an increase in alcohol use. Those who increased alcohol use during quarantine were older individuals (CI: 0.04-0.1, $p < .0001$), essential workers (CI: -0.58- -0.1, $p = .01$), individuals with children (CI: -12.46-0.0, $p = .003$), those with a personal relationship with someone severely ill from COVID-19 (CI: -2- -0.38, $p = .01$), and those with higher depression (CI: 0.67-1.45, $p < .0001$), anxiety (CI: 0.61-1.5, $p = .0002$), and positive urgency impulsivity (CI: 0.16-0.72, $p = .009$). Further, country-level sub-sample analyses indicated that drinking amount (CI: 9.36-13.13, $p = .003$) increased in the United Kingdom during quarantine.

Conclusions: Our findings highlight a role for identifying those vulnerable for alcohol misuse during periods of self-isolation and underscore the theoretical mechanism of negative emotionality underlying drinking behaviours driven by stress. Limitations include a large degree of study dropout ($n = 1,515$). Future studies should assess the long-term effects of isolation on drinking behaviours.

Keywords: COVID-19; alcohol use; stress; depression; self-isolation

ARTICLE SUMMARY

Strengths and limitations of this study

- The HabiT study sampled drinking behaviours of a large, diverse population during the COVID-19 pandemic.
- Changes in drinking behaviours were assessed against specific COVID-19-related stress factors.
- Due to the length of the survey (8-10 minutes), we observed a large degree of study dropout.
- Subjects were within varying phases of lockdown during the time of testing.
- The prevalence of diagnosed Alcohol Use Disorder drinkers sampled was low, likely related to sampling issues or under-reporting.

INTRODUCTION

The Coronavirus (COVID-19) pandemic has necessitated drastic safety measures to control the virus spread. These measures included an extended self-isolation period in which individuals were permitted to leave their places of residence only to obtain amenities (e.g., food, medical care, toiletries, etc.) or engage in essential work. Individuals were not permitted face-to-face contact with anyone who did not reside within their immediate households. In the United Kingdom, these measures were instituted nationally on March 23rd, 2020, with a gradual lifting of restrictions on May 10th, 2020 ending on July 4th, 2020 with locality-specific intermittent reinstatement of these measures. Although a necessary precautionary measure to mitigate the devastating effects of COVID-19 on public health, evidence indicates that protracted periods of self-isolation, especially in the context of stress, may be related to acute and prolonged negative mental health consequences, particularly in individuals already struggling with psychiatric disorders.[1]

Indeed, current clinical reports from individuals in treatment for Substance Abuse Disorder indicate that the stress produced by COVID-19 social isolation measures have triggered greater and more frequent drug or alcohol cravings, subsequently leading to relapse.[2] This observation is relevant to a prominent mechanistic theory of negative emotionality underlying alcohol misuse.[3] The relationship between stress and alcohol consumption is widely recognised and can be observed in an experimental fashion.[4] In subjects with known Alcohol Use Disorder (AUD), stress and experimental manipulations of stress enhance the amount of alcohol consumed [5, 6], alcohol craving [7], problematic drinking behaviours, and likelihood of relapse.[8] Exposure to stress triggers relapse characterised by a re-instantiation of alcohol cravings and alcohol-seeking behaviours.

Increases in alcohol craving and consumption after stress exposure also occur in those without AUD. An increase in alcohol consumption is often used as a coping strategy for both chronic and specific stressful life events in both AUD and non-AUD drinkers.[9] Similarly in both groups, self-reported craving and subjective judgements of alcohol value rise following a stress task [10], and social drinkers consume more alcohol after witnessing a social stressor.[11] These relationships are moderated by gender [12], age [13], previous alcohol exposure [13], alcohol

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3 expectancies [14], and the pattern of alcohol consumption.[15] Further, psychiatric
4 symptomology such as anxiety and depression as well as pathological levels of personality traits
5 such as impulsivity are widely recognised predisposing factors to problematic alcohol use and
6 addiction.[3, 16]
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11 Thus, in response to these exceptional circumstances, we aimed to assess how social isolation
12 measures in the midst of the COVID-19 pandemic may have affected drinking behaviours in the
13 general adult population. We developed an international survey, entitled Habit Tracker (HabiT),
14 which evaluated drinking severity before (post-hoc recall) and during the COVID-19 quarantine
15 period. We hypothesised that changes in amount of alcohol consumption and severity of drinking
16 behaviours may be related to specific COVID-19 related stress factors, as well as demographic
17 and psychiatric factors. Further, we investigated if COVID-19-related stress factors influenced
18 changes in drinking amount, drinking severity, depression, and anxiety before and during
19 quarantine.
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28 **METHODS**

29 **Recruitment and inclusion criteria**

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31 The HabiT survey was a questionnaire that sought to assess the effects of isolation on alcohol,
32 smoking, and internet use. The effects on alcohol use are reported here. Subjects were included if
33 they were 18 years of age or older and confirmed they were proficient in reading and
34 understanding English. HabiT was advertised by University of Cambridge news page on May
35 11th, 2020, a day before its international release. For the next several days, the survey was
36 disseminated by news agencies throughout the United Kingdom (e.g., The Telegraph, BBC
37 Cambridgeshire, News Wise) as well as throughout various University of Cambridge colleges.
38 Further, the survey was posted and shared on personal and public social media sites (i.e.,
39 Facebook, Twitter). HabiT was approved by the Cambridge Psychology Research Ethics
40 Committee. All subjects gave informed consent and were not financially compensated for their
41 participation, although informed that- upon survey completion- they would be provided results of
42 the study through request. The data collected was fully anonymised. The survey was created
43 using Qualtrics (Provo, Utah) survey-building platform. Developed iteratively within-lab and
44 among co-authors to insure brevity and consistency, the average time to complete the survey was
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3 approximately 8-10 minutes, and all subjects could participate on either a computer or smart
4 phone device.
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8 **Patient and public involvement statement** 9

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11 We did not involve patients or the public in the research design, reporting, or survey
12 dissemination strategies of this study.
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16 **Demographic information** 17

18 The demographic information collected were as follows: age, gender, socioeconomic status,
19 intimate relationship status, country and city of residence, and any previous or current diagnosis
20 of a psychiatric or neurological disorder.
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26 **Attentional checks** 27

28 Every major section of the survey contained at least one question which served as an attentional
29 check to ensure subjects were correctly reading and answering survey questions to the best of
30 their ability. The attentional checks were structured to mirror the Likert scaling of each section
31 (e.g., “If you are reading this question, please select ‘Strongly Agree.’”).
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37 **Frequency and severity of alcohol consumption before and during the quarantine period** 38

39 We first asked subjects if they drank alcohol. If the answer was negative, they proceeded to the
40 next set of questions. If the answer was positive, we assessed the change in the amount and
41 severity of alcohol use as well as the current severity of alcohol use. We asked subjects to report
42 the following behaviours within a typical week in November (i.e. pre-quarantine) and within the
43 last week (i.e. during quarantine): (i) the number of units of alcohol consumed within the last
44 week with examples for the number of units for differing types of alcohol and sizes provided; (ii)
45 the change in severity using a time-scale adaptation of the first three questions of the Alcohol
46 Use Disorders Identification Test (AUDIT-C).[17] Subjects were asked to report how many days
47 in the last week they consumed an alcoholic beverage, how many drinks they consumed on a
48 typical day they were drinking in the last week, and how often they consumed six or more drinks
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3 on one occasion in the last week. To assess the current severity of drinking behaviours during
4 quarantine, we used a timescale-adapted version of the full AUDIT [18] which assessed problem
5 drinking behaviours within the last week such as an inability to stop drinking once started, failure
6 to perform responsibilities, feeling guilt or remorse, drinking shortly after waking to ease the
7 adverse physiological effects of drinking the night before, drinking to the point of memory loss,
8 injuring oneself or others due to drinking, and concern from a loved one or medical professional
9 related to the frequency or severity of one's drinking. We used two primary outcome measures:
10 the change in severity (AUDIT-C) corroborated with the secondary change in amount of
11 drinking (units per week) and current severity (full AUDIT).
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20 **COVID-19-related stress factors**

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22 We assessed 10 factors which may contribute to COVID-19-related stress using the following
23 questions:
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- 27 1. Have you been deemed an "essential worker" by your government?
- 28 2. Do you work for health care services specifically with individuals who have contracted
29 Coronavirus (COVID-19)? (Sub-question of question 1)
- 30 3. Has your employment situation changed due to the Coronavirus (COVID-19) crisis?
- 31 4. Has anyone you know personally contracted or have shown symptoms characteristic of
32 Coronavirus (COVID-19)?
- 33 5. Has anyone you know personally become severely ill or died due to contracting
34 Coronavirus (COVID-19)?
- 35 6. Are you isolated alone?
- 36 7. Do you have children?
- 37 8. If you have children, are you their only caretaker? (Sub-question of question 7)
- 38 9. If you are currently in isolation with others, how would you describe the quality of your
39 relations?
- 40 10. How often do you currently go outdoors (for work, essential duties, leisure, etc.)?
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Psychiatric measures

Depression and anxiety symptomology were measured using The Hospital Anxiety and Depression Scale (HADS); a brief, validated four-item questionnaire.[19] As a secondary analysis, we assessed impulsivity using the validated Short Impulsive-Behavior Scale (SUPPS-P).[20] This scale provides an overall impulsivity score, as well as five scores corresponding to impulsivity subscales: perseveration, lack of premeditation, sensation-seeking, negative urgency, and positive urgency.

Statistical analysis

Statistical analyses were performed using MATLAB (Version 2020a). All subjects who answered the attentional checks incorrectly (n=12), reported highly improbable answers regarding the units of alcohol they consumed weekly (e.g., 1,000 units), did not report their gender, or did not complete the psychiatric questionnaires were excluded from further analysis, leaving a total of 1346 subjects. Drinking severity scores of the sample were non-normally distributed (Shapiro-Wilk, $p < .05$), thus non-parametric tests were used.

We used Mann-Whitney U-tests to compare weekly alcohol unit consumption and alcohol severity before and during quarantine in the full group. Then, we divided subjects into three groups, those who during quarantine either increased, decreased, or did not change their alcohol consumption and performed a Kruskal-Wallis H-test to assess the relative drinking amount to severity indices of these groups.

We then assessed which COVID-19-related stress factors were associated with changes in either amount (alcohol units consumed per week), change in severity (AUDIT-C), current severity (full AUDIT), or current depression and anxiety using the following tests: 1) Mann-Whitney U-Tests to compare negative versus positive responses to the COVID-19 stress factors (MW), 2) MANCOVA [21] controlling for gender and age (MAN1), and 3) A second MANCOVA controlling for age, gender, depression, and anxiety symptomology (MAN2). For the MANCOVA tests, variables 'age,' 'depression severity,' and 'anxiety severity' were dichotomised via median split. For the COVID-19 stress primary factor comparisons (eight items), we used False Discovery Rate (FDR) to control for multiple comparisons with

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3 significance assigned at $p < .05$. [22, 23] Confidence intervals (CIs) are provided with p values
4 for significant findings observed from the most stringent statistical test.
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8 On an exploratory basis, we then used Spearman's partial correlation to compare the drinking
9 severity indices of subjects who completed the timescale-adapted full AUDIT with SUPPS-P and
10 HADS scores to relate drinking severity of the overall sample to psychiatric measures. Lastly, in
11 order to assess possible directional relationships in changes in the severity of drinking behaviors
12 to depression, anxiety, and impulsivity; we performed Spearman's partial correlations with the
13 psychiatric questionnaires among the three aforementioned groups (i.e., increased, decreased,
14 and null). For both correlational analyses, we used FDR correction ($p < .05$) for multiple
15 comparisons.
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22 RESULTS

23 Demographic information

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25 A total of 2,873 subjects participated (data collection: 05/12/2020 to 05/28/2020) of which 1,346
26 had usable data based on defined criteria (1,515 dropouts; 46.9% accurately completed; please
27 refer to the supplementary materials for a demographic analysis of those who did not complete
28 the survey). Of these subjects, 859 (63.8%) reported that they drink alcohol (please refer to the
29 supplementary materials for demographic information for those report drinking alcohol). Of the
30 1346 subjects, the average age was 28.92 ± 10.45 years [CI: 28.2-29.53] (range= 18-90) with
31 more males (males: $n= 1006$; females: $n=325$; other: $n=15$) from 85 different countries of
32 residence, with the majority from the United Kingdom ($n= 434$) and the United States ($n= 355$),
33 followed by Canada ($n= 64$) and Germany ($n= 63$). Marital status was as follows: single: $n=785$;
34 married or committed: $n=571$; divorced or separated: $n=33$; widowed: $n=4$. Socioeconomic
35 status (as denoted by annual income in raw currency on the country-level and converted to UK
36 pounds during analysis) was as follows: $<19.9k$: $n=285$; $20-39.9k$: $n= 273$; $40-69.9k$: $n=244$; $70-99.9k$:
37 $n=241$; $>100k$: $n=203$; and 232 subjects did not report their incomes.
38 Current psychiatric or neurological diagnoses were as follows: no diagnosis: $n=1192$; depression:
39 $n= 60$; anxiety: $n= 38$; Post-Traumatic Stress Disorder (PTSD): $n= 5$; comorbid depression and
40 anxiety: $n= 46$.
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Overall changes in drinking frequency and severity before and during quarantine

Of the total sample, the change in problem drinking severity (AUDIT-C) was 0.89 ± 1.43 [CI: 0.81-0.96] (range: 0-8) and the mean change in the amount consumed was 5.62 ± 9.55 units per week [CI: 3.16-4.02] (range: 0-120). The current problem drinking severity (full AUDIT) was 3.14 ± 4.47 [CI: 2.9-3.37] (range: 0-32), with 557 subjects included that do not consume alcohol. Of the subjects who reported they consume alcohol ($n= 859$), the change in severity from pre-quarantine to quarantine was a decrease of 1.53 ± 1.6 , [CI: 5.01-5.64] range 0-8 ($U= 2.65$, [CI: 0-0.21] $p= .008$). The units of alcohol consumed per week was significantly decreased during the quarantine period (8.03 ± 14.22 units, [7.11-8.94] range= 1-120) compared to November (8.32 ± 11.92 units, [CI: 7.47-9.02] range = 0-150), $U= -2.29$, [CI: 0.0-0.0] $p= .02$ (Figure 1). However, in the UK, the units of alcohol consumed per week was significantly increased during the quarantine period (11.25 ± 17.73 units, [CI: 9.36-13.13] range= 1-120) compared to November (10.94 ± 14.17 units, [CI: 9.44-12.45] range = 0-150), $U= 3.0$, [CI: 0-0.7] $p= .003$. (For full country-level sub-analyses of drinking behaviours, as well as severity of lockdown and amount of confirmed COVID-19 cases and deaths during the data collection period by country via Coronavirus Government Response Tracker [24]; please refer to the supplementary materials). Of the international sample, 172 (20%) subjects reported abstinence from alcohol consumption during the quarantine period.. More subjects reported a decrease ($n= 384$, 45%) or an increase ($n= 308$, 36%) as opposed to no change ($n= 166$, 19%) of weekly alcohol consumption from November to the quarantine period ($X^2= 72.86$, $p= .001$; Figure 1).. Of the three groups, those who: 1) increased weekly units consumed during quarantine (7.5 ± 10.5 change in units, [CI: 6.33-8.7] range: 1-80), 2) decreased weekly units consumed during quarantine (-6.5 ± 9.5 change in units, [CI: -7.45- -5.55] range: -.2 - -120), and 3) did not change their weekly unit consumption, subjects who had increased the units of alcohol consumed during the quarantine period showed significantly higher current drinking severity scores (7.5 ± 5.6 , [CI: 6.89-8.15] range: 1-32) than those who reported decreases (3.5 ± 3.0 , [CI: 3.16-3.76] range: 1-21) or no changes (4.8 ± 3.6 , [CI: 4.17-5.23] range: 1-20) in weekly unit consumption ($H= 165.33$, [CI: 3.35-4.78] $p < .0001$, Figure 1).

[INSERT FIGURE 1 & FIGURE 1 LEGEND HERE]

COVID-19 stress factor evaluation

The change in amount of drinking was positively correlated with age ($r_s = 0.2$, [CI: 0.04-0.1] $p < .0001$), and gender with males (6.44 ± 10.8 units, [CI: 5.63-7.35] range: 0-120) showing an increased change in drinking amount relative to females (3.81 ± 5.18 , [CI: 3.08-4.32] range: 0-38) or other genders (1.32 ± 1.65 , [CI: 0.18-2.24] range: 0-5) ($H = 8.17$, $p = .003$). Changes in drinking severity were also related to both age and gender, with older individuals ($r_s = .2$, [CI: 0.01-0.02] $p < .0001$) and males (1.68 ± 1.74 , [CI: 1.55-1.83] range: 0-8) demonstrating greater changes in their drinking severity than females (1.16 ± 1.12 , [CI: 1.02-1.3] range: 0-8) and others (1.36 ± 1.29 , [CI: 0.54-2.18] range: 0-3) ($H = 6.02$, [CI: -0.81- -0.22] $p = .05$). (Gender-specific sub-analyses of drinking behaviours can be found in the supplementary materials). Thus, we utilised age and gender as covariates for both MANCOVA analyses. All relevant covariates used in these analyses were dichotomised via median split (age= 25.1 years, depression severity= 2, and anxiety severity= 1).

Primary COVID-19 stress factors

The influence of COVID-19 stress factors on the change in drinking severity, amounts consumed, and current drinking severity are reported in Tables 1, 2, and 3, respectively. Designated essential workers and those with children showed a greater increase in the amount consumed weekly and drinking severity as well as greater current severity. This remained significant including when controlled for demographic variables (age, gender) and psychiatric symptoms (depression, anxiety). Notably, although subjects with children reported an increase in the number of units of alcohol and severity of alcohol use, they also reported lower levels of depression and anxiety. Knowing an individual personally who was ill or severely ill with Covid-19 showed higher current alcohol drinking severity than those who did not, but with no change from pre- to post-quarantine. A reported change in employment status and isolating alone was associated with greater depression scores, with no differences in drinking behaviours. Isolating with others but reporting a poor relationship was associated with greater depression and anxiety, however, the lower drinking behaviours were moderated by age and gender effects. Finally, going outdoors was associated with greater current drinking severity and greater depression and

anxiety scores controlling for all variables. Post-hoc tests confirmed that, in cases in which a significant relationship was lost between an item and either changes in drinking frequency or severity due to controlling for age and gender (i.e., MANCOVA 1), age was the sole contributor (Essential worker: $F(1, 533.2) = 7$, [CI: 0.15-2.1] $p = .008$; Others ill: $F(1, 879.9) = 52.6$, [CI: 1.7-2.7] $p < .0001$; Poor relationship: $F(1, 933.9) = 48.88$, [CI: 1.8-2.8] $p < .0001$).

Stress Factor	N Total	Yes M(SD)	N Yes	No M(SD)	N No	MW p-value	MAN1 p-value	MAN2 p-value	CI
Essential worker	1337	0.16(1.9)	241	-0.21(1.6)	1096	0.02*	0.01*	0.01*	-0.58- -0.1
Employment	1337	-0.14(1.8)	323	-0.14(1.6)	1014	0.83	0.96	0.92	
Others ill	1334	-0.17(1.8)	497	-0.12(1.6)	837	0.75	0.64	0.63	
Others severely ill	1336	-0.01(2)	127	-0.15(1.6)	1209	0.35	0.7	0.69	
Isolated alone	1325	-0.1(1.9)	168	-0.15(1.6)	1157	0.83	0.85	0.82	
Having children	1334	0.34(1.4)	209	-0.23(1.7)	1125	<.0001*	0.005*	0.003*	-12.46-0.0
Poor relationship	1168	-0.3(1.7)	187	-0.13(1.6)	981	0.35	0.7	0.69	
Going outdoors	1336	-0.27(1.3)	193	-0.12(1.7)	1143	0.26	0.7	0.69	

Table 1. COVID-19 primary stress items relationship with changes in drinking severity (as indexed by the AUDIT-C) from pre-quarantine to quarantine.

Stress Factor	N Total	Yes M(SD)	N Yes	No M(SD)	N No	MW p-value	MAN1 p-value	MAN2 p-value	CI
Essential worker	1337	1.26(12.8)	241	0.45(7.5)	1096	0.0003*	0.07	0.08	-3.4- -0.02
Employment	1337	0.17(11.2)	323	0.13(7.8)	1014	0.77	0.95	0.97	
Others ill	1334	0.05(7.1)	497	0.2(9.6)	837	0.83	0.95	0.97	
Others severely ill	1336	0.06(7.6)	127	0.15(8.9)	1209	0.83	0.95	0.97	
Isolated alone	1325	0.05(11.6)	168	0.2(8.2)	1157	0.46	0.95	0.97	
Having children	1334	2.02(11.9)	209	0.54(7.9)	1125	<.0001*	0.04*	0.02*	-3.6- -0.74
Poor relationship	1168	0.4(6.1)	187	0.19(8.7)	981	0.46	0.95	0.97	
Going outdoors	1336	1.23(6.8)	193	0.04(9.0)	1143	0.15	0.47	0.4	

Table 2. COVID-19 primary stress items relationship with changes in drinking amount (in units) from pre-quarantine to quarantine.

Stress Factor	N Total	Severity Type	Yes M(SD)	N Yes	N M(SD)	N No	M-W p-value	MAN1 p-value	MAN2 p-value	CI
Essential worker	1337	Drinking	4.42(5.7)	243	2.85(4.1)	1099	<.0001*	0.0005*	0.0005*	-1.8- -0.57
		Depression	2.29(1.8)	243	2.44(1.9)	1099	0.43	0.84		
		Anxiety	1.79(1.7)	243	1.94(1.8)	1099	0.42	0.8		
Employment change	1337	Drinking	3.46(4.9)	324	3.02(4.3)	1018	0.38	0.08	0.144	
		Depression	2.78(2.0)	324	2.31(1.9)	1018	0.0043*	0.007*		-0.58- -0.1
		Anxiety	2.03(4.5)	324	1.88(1.8)	1018	0.32	0.363		
Others ill	1334	Drinking	3.59(1.9)	499	2.87(4.4)	840	<.0001*	0.1	0.125	-1.2- -0.2
		Depression	2.3(1.8)	499	2.47(1.9)	840	0.20	0.83		
		Anxiety	1.9(5.5)	499	1.93(1.9)	840	0.99	0.94		
Others severely ill	1336	Drinking	4.49(2.0)	127	2.99(4.3)	1214	0.001*	0.007*	0.01*	-2- -0.38
		Depression	2.45(2.0)	127	2.4(1.9)	1214	0.99	0.41		

		Anxiety	1.92(5.8)	127	1.91(1.8)	1214	0.82	0.84		
Isolated alone	1325	Drinking	3.88(2.0)	169	2.98(4.2)	1161	0.42	0.83	0.87	
		Depression	3.4(1.9)	169	2.41(1.9)	1161	0.009*	0.04*		-0.7- -0.06
		Anxiety	2.04(5.2)	169	1.9(1.8)	1161	0.43	0.11		
Having children	1334	Drinking	5.17(1.8)	211	2.75(4.2)	1128	< 0.001*	0.0003*	<.0001*	-2.4- -0.9
		Depression	1.5(1.7)	211	2.58(1.9)	1128	<.0001*	<.0001*		0.37-0.97
		Anxiety	1.37(1.7)	211	2.02(1.9)	1128	<.0001*	0.0009*		0.25-0.85
Poor relationship	1168	Drinking	2.82(5.1)	187	3.1(4.1)	985	0.01*	0.92	0.87	0.4- 1.0
		Depression	3.57(2.0)	187	2.2(1.8)	985	<.0001*	<.0001*		-1.53- -1
		Anxiety	2.79(2.0)	187	1.74(1.8)	985	<.0001*	<.0001*		-1.3- -0.73
Going outdoors	1336	Drinking	3.42(4.5)	1148	1.37(3.4)	193	<.0001*	<.0001*	<.0001*	1.14-2.47
		Depression	3.18(2.0)	193	2.28(1.9)	1148	<.0001*	<.0001*		-1- -0.42
		Anxiety	2.42(2.0)	193	1.83(1.8)	1148	0.0002*	0.0008*		-0.8- -0.24

Table 3. COVID-19 primary stress items relationship with current drinking severity (i.e., full AUDIT), depression, and anxiety from pre-quarantine to quarantine.

Secondary COVID-19 stress factors

Two COVID-19 stress factors were considered secondary as they represented a subset of a primary factor. Working for health care services was associated with a trend towards a greater change in amount of units consumed ($F = 3.97$ [CI: -6.73- -0.0], $p = .05$) and greater severity of current drinking ($F = 7.01$, [CI: -3.9- -0.6] $p = .007$) when controlled for all variables. Being the only caretaker for children was also associated with greater change in drinking severity ($U = 2.62$, [CI: -2.7- -0.9] $p = .009$) and greater change of amount consumed ($U = 2.67$, [CI: -4.5- -0.8] $p = .007$), but was no longer significant when controlling for age and gender.

Drinking severity during quarantine and correlations with psychiatric measures

Of the individuals who reported drinking alcohol, ($n = 769$) completed the current drinking severity index (e.g., the adapted-timescale full AUDIT). The severity of drinking behaviours was positively related to depression ($r_s = .12$, [CI: 0.34-.79] $p = .004$), anxiety ($r_s = .12$, [CI: 0.3-0.74] $p = .027$), and positive urgency impulsivity ($r_s = .12$, [CI: 0.14-0.34] $p = .004$), controlled for age and gender. To assess potential directional relationships between current drinking severity during quarantine and psychiatric measures, we correlated depression, anxiety, and impulsivity with the three drinking groups (i.e., increased, decreased, null). Drinking severity scores in the decreased and no change groups were not significantly correlated with any of the psychiatric measures of interest. However, drinking severity of those who increased their units consumed during the

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3 quarantine period were related to depression ($r_s = .30$, [CI: 0.67-1.45] $p < .0001$), anxiety ($r_s = .23$,
4 [CI: 0.61-1.5] $p = .0002$), and positive urgency ($r_s = .17$, [CI: 0.16-0.72] $p = .009$) (Figure 2).
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9 [INSERT FIGURE 2 & FIGURE 2 LEGEND HERE]
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11 DISCUSSION

12 We show an overall decrease in amounts and severity of problem alcohol use from pre-
13 quarantine to the quarantine period. Critically, however, three different subpopulations were
14 identified with most either increasing or decreasing use as compared to remaining unchanged in
15 their alcohol use behaviours. Greater drinking was associated with demographic factors
16 including age and male gender, COVID-19 stress-related factors, and psychiatric factors such as
17 depression, anxiety, or the impulsivity subscale of positive urgency. Our findings underscore the
18 theoretical mechanism of negative emotionality underlying drinking behaviours driven by stress,
19 depression, and anxiety.
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29 An overall decrease in alcohol use and problematic use may have multiple potential etiologies.
30 Stringent lockdown may be associated with a decrease in the presence or availability of alcoholic
31 beverages within the immediate household given limitations in access, a decrease in exposure to
32 alcohol cues that may trigger urges, or the preference to consume alcohol within social contexts.
33 More subjects reported either decreasing or increasing the frequency of their alcohol intake as
34 compared to remaining unchanged, consistent with previous reports of a greater tendency toward
35 extremes in individual drinking patterns when faced with either acute or chronic life
36 stressors.[15]
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45 Older individuals showed a greater increase in drinking behaviours during lockdown and current
46 severity of problem drinking consistent with demographic factors known to be associated with
47 alcohol misuse. Whether one increases their drinking after experiencing acute or chronic life
48 stress is age-dependent, which may reflect a function of previous alcohol experience.[13] Age
49 may play a particularly unique role in the context of COVID-19 due to the greater need for
50 stringent isolation with age, potentially fewer supports, and the risk of greater isolation,
51 loneliness, and concern about the impact of COVID-19 on one's personal health. Expectedly,
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3 males showed greater unit consumption compared to females and other genders overall.
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5 However, males showed a decrease in both drinking amount and severity during quarantine,
6
7 while females demonstrated the opposite trend. This finding corroborates evidence which
8
9 indicates females are more likely than males to consume alcohol in order to cope with stress.[25]

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12 COVID-19 specific stress factors appear to influence drinking behaviours controlled for other
13
14 confounding variables. Being deemed an essential worker and having children was associated
15
16 with a greater increase in drinking behaviours during quarantine. Importantly, although having
17
18 children was associated with an increase in alcohol use, depression and anxiety scores were
19
20 lower than in those without children. This suggests the additional burden of childcare and home
21
22 schooling contributed to the tendency towards drinking possibly in the context of stress relief and
23
24 was not mediated by greater depression or anxiety symptoms. The presence of children may also
25
26 be protective against depressive and anxiety symptoms during lockdown. Having children may
27
28 mitigate against loneliness that has been highlighted as a major issue during the isolation of
29
30 lockdown.[26] A subset of the essential worker category – health care workers responsible for
31
32 taking care of individuals with COVID-19 – was associated with greater severity of problem
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34 drinking behaviours. Thus, the specific impact of lockdown on the necessity for essential
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36 workers and the impact of the burden of home schooling and childcare on parents appears to
37
38 enhance drinking behaviours independent of an impact on psychiatric symptomatology.

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40 As expected, having a personal relationship with someone who had become severely ill or died
41
42 due to COVID-19 was associated with a greater increase in severity of problem drinking
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44 behaviours. Going outdoors more frequently for work, exercise, or essential duties during
45
46 lockdown was similarly associated with greater severity of alcohol use, as well as depressive and
47
48 anxiety symptoms. The reasons behind the need to go outdoors complicate the interpretation, as
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50 it might be confounded by being an essential worker but also allow for greater access to the
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52 purchase of alcohol. Living with others but having a poor quality of relationship was
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54 unexpectedly associated with a lower drinking severity but with greater depressive and anxiety
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56 symptoms. Living alone was not associated with any changes in drinking behaviours but was
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58 associated with greater depressive symptomatology. These findings might support the role of
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3 drinking in the context of social interactions; and further highlight the importance of social
4 interactions during lockdown, the role of loneliness, and its impact on mental health.[26]
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6 Importantly, those residing in the UK- unlike those in the US and Canada- displayed an increase
7
8 in weekly alcohol units consumed during quarantine, consistent with the WHO Global Status
9
10 Report on Alcohol and Health (2018) which shows that total alcohol per capita consumption
11
12 (APC) is higher in the UK than in the US or Canada.[27]
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14
15 We further observed a relationship between the current severity of drinking behaviours and
16
17 psychiatric symptoms such as depression, anxiety or positive urgency. These relationships were
18
19 driven particularly by the group which increased their drinking during quarantine. That both
20
21 negative and positive emotionality factors are associated with increased drinking behaviours is in
22
23 keeping with the multiple paths towards alcohol use. The effects of depression and anxiety on
24
25 alcohol consumption in both AUD and non-AUD drinkers are well-documented [28-31] and
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27 related to mechanistic theories of negative emotionality, which suggest that individuals may
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29 increase their alcohol consumption in stressful contexts to cope with aversive emotional
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31 states.[32] Positive emotional factors appear to also play a role in the association with positive
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33 urgency, a subtype of impulsivity characterised by the propensity to engage in disinhibited
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35 behaviors including alcohol consumption when experiencing an intensified hedonic or excited
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37 state.[31] Positive affect-based impulsivity may reflect a heightened reward sensitivity
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39 associated with problem drinking behaviours.[33]
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41 **Limitations and future directions**

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43 This study is not without limitations. HabiT is a cross-sectional, retrospective survey and hence
44
45 potentially limited by recall and misclassification biases as well as lack of longitudinal follow-
46
47 up. Because retrospective reporting involves issues with memory, possible Dunning-Kruger
48
49 effects, and selection bias; the reader should be cautious in drawing causal interpretations from
50
51 the current data. Because the aim of the HabiT study was to investigate changes in frequency and
52
53 severity of drinking behaviour in a large, wider population, we issued the survey internationally
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55 and during a later period of enforced isolation. Thus, the possibility cannot be overlooked that
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57 subjects were within varying phases of lockdown characterised by differential restrictions during
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3 the time of testing which may have influenced our current results. Future studies may consider
4 data analysis by country, level of lockdown, or amount and severity of localised COVID-19
5 cases. Also, approximately half of the individuals who began the survey did not complete it. This
6 may be due to the length of the survey (i.e., 8-10 minutes). Prospective studies using an online
7 survey design should further condense questionnaires and/or offer subjects monetary incentives
8 obtained upon survey completion in order to attenuate dropout and non-response bias. The
9 current HabiT survey only assessed the *acute* effects of COVID-19 isolation measures on
10 changes in drinking behaviours in comparison to the pre-quarantine period. Hence, follow-up
11 studies should be employed during the immediate post-quarantine period to investigate the
12 possible protracted effects of COVID-19 isolation on drinking behaviours. Furthermore, whether
13 the sampling adequately reflects the population distribution in the form of sampling bias may be
14 an issue with online questionnaires and may under-represent those who do not have smartphones
15 or access to the internet [34], have limited facility with online questionnaires (e.g., older
16 individuals) [34], were otherwise engaged (e.g., caring for an ill individual or children), or are
17 more severely ill with substance use or other mental health disorders. Thus, our ability to
18 generalise our current findings to the wider population is limited. Other methods (e.g., phone
19 surveys) are recommended to reach populations under-represented by online surveys.[35] As few
20 respondents reported a previous history of alcohol problems relative to the expected prevalence
21 rates, the reporting is likely either a function of sampling bias, limited willingness to reveal such
22 a history in an online survey, or marked changes in alcohol use particularly if relapse occurs.
23 This limits our capacity to assess the change in drinking behaviours in those with a history of
24 alcohol problems. Further studies focusing specifically on the newly abstinent or those with a
25 history of alcohol problems are indicated.
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46 CONCLUSION

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48 Although alcohol drinking behaviours appeared to decrease overall during lockdown, we
49 emphasise that specific groups may be at higher risk for developing problematic alcohol use
50 behaviours. In particular, factors associated with an increase in alcohol use include older
51 individuals, essential workers, parents with children, those with a personal relationship with
52 someone severely ill from COVID-19, and those with higher depression, anxiety levels, or
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3 positive urgency impulsivity. Further, unlike residents from the US and Canada, those in the UK
4 increased their weekly alcohol intake during the quarantine period. We emphasise that those with
5 a previous history of alcohol misuse or a family history of AUD were not the specific focus of
6 this study and may represent a high risk group which requires further investigation. Alcohol can
7 be used in brief, moderate amounts in a healthy, non-pathological manner related to socialisation
8 and stress relief. However, a subgroup of these individuals may still be at higher risk for longer
9 term issues with alcohol misuse. The lockdown resulted in a unique set of stressors that in some
10 cases may persist (e.g. childcare, grieving, prolonged depression or anxiety related to the
11 lockdown) and might again re-emerge with the imposition of localised lockdowns or further
12 lockdowns in the context of a second wave. Further studies on the longitudinal impact and
13 persistence of these behaviours are critical. Our findings highlight a need for identifying those at
14 greater risk for alcohol misuse to aim for greater support services and proactively target mental
15 health issues associated with problem drinking behaviours such as depression or anxiety.
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31

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33 potential conflicts of interest.
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37 **Author Contributions:** SS created the HabiT survey, collaborated with VR in analysing the
38 collected data, and drafted and edited the manuscript. VR coded and analysed the data. HBJ
39 collaborated with VV in conceptualising the study. VV conceptualised the study, gave crucial
40 guidance in creating the HabiT survey, and edited the manuscript.
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46 **Data Statement:** All participant data used in this research is deidentified. Participant data and
47 MATLAB statistical code used for analysis is available upon reasonable request from
48 corresponding author, Samantha N. Sallie, at habittstudy2020@gmail.com.
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LEGENDS FOR FIGURES

Figure 1. Changes in amount and severity of drinking behaviours in the HabiT sample between pre-quarantine and quarantine periods. Units of alcohol consumed weekly (top left) and changes in drinking severity (AUDIT-C) (bottom right) decreased during the quarantine period and more individuals either increased or decreased their weekly units consumed during quarantine than remained the same (top right). Further, those who increased their weekly alcohol unit consumption during the quarantine period had significantly higher drinking severity indices (full AUDIT) compared to those who decreased or did not change their drinking behaviours during the quarantine period (bottom left).

Figure 2. Regression plots of the significant relationships between drinking severity and psychiatric measures in subjects who increased weekly alcohol unit consumption during quarantine. Drinking severity indices of the group who increased their drinking during the quarantine period were significantly positively related to depression severity, anxiety severity, and positive urgency (impulsivity subset).

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2 COVID-19 pandemic: a call for action for mental health science. *The Lancet Psychiatry*. 2020
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For peer review only

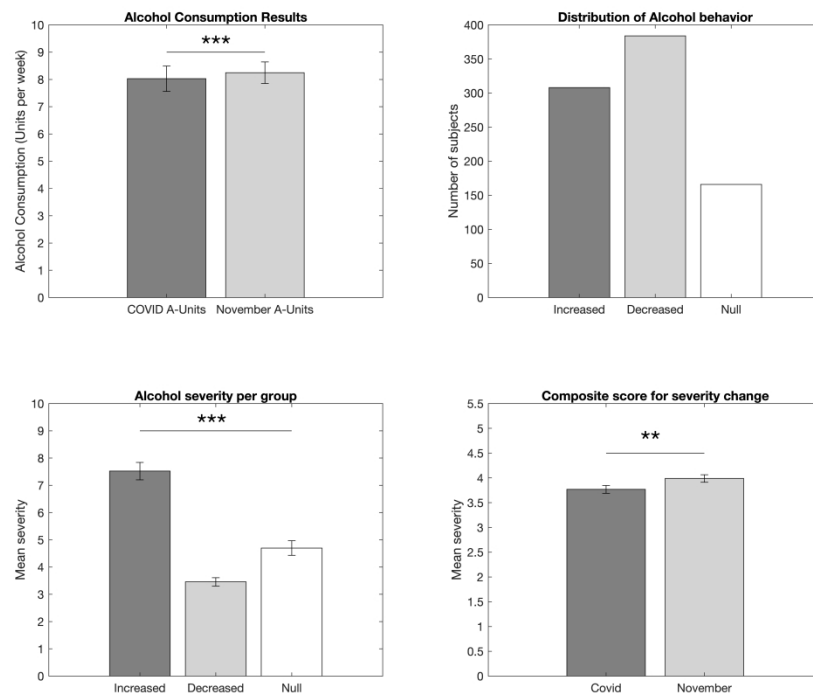


Figure 1. Changes in amount and severity of drinking behaviours in the HabiT sample between pre-quarantine and quarantine periods. Units of alcohol consumed weekly (top left) and changes in drinking severity (AUDIT-C) (bottom right) decreased during the quarantine period and more individuals either increased or decreased their weekly units consumed during quarantine than remained the same (top right). Further, those who increased their weekly alcohol unit consumption during the quarantine period had significantly higher drinking severity indices (full AUDIT) compared to those who decreased or did not change their drinking behaviours during the quarantine period (bottom left).

299x238mm (600 x 600 DPI)

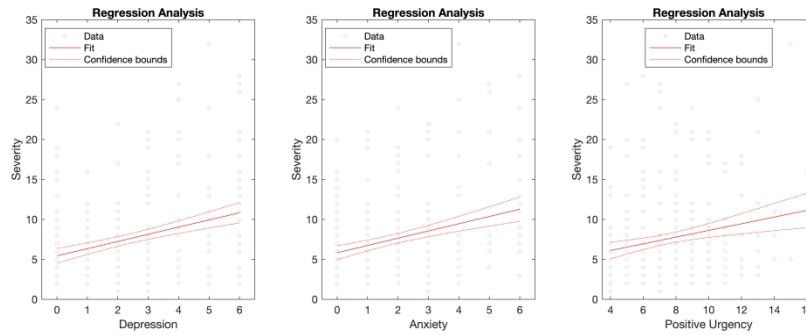


Figure 2. Regression plots of the significant relationships between drinking severity and psychiatric measures in subjects who increased weekly alcohol unit consumption during quarantine. Drinking severity indices of the group who increased their drinking during the quarantine period were significantly positively related to depression severity, anxiety severity, and positive urgency (impulsivity subset).

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SUPPLEMENTARY MATERIALS

Demographics for drinkers

	Age		Sex		Country		SES		Relationship
Mean	31.4	Male	599	Total	49	Lower	328	Single	449
SD	13.2	Female	248	UK	347	Mid	176	Relationship	408
Range	18-90	Other	12	US	223	Higher	250		
	Depression		Anxiety		PTSD		Depression & Anxiety		
	41		27		3		35		

Demographic analysis for study dropouts

Although a majority of the dropout subjects (n=1,515) who entered the study provided no data (n=981), we performed a demographic analysis on dropout subjects who provided this information (n=481) to assess if those who completed the survey differed in demographic factors from those who did not. The mean age of dropout subjects was 26.58 ± 11.11 years [CI: 25.59-27.58] (range= 18-80 years), significantly younger than the mean of age of individuals who completed the survey ($U= 3.69$, [CI: 1.15-3.54] $p < .0001$). Further, more males (n=387) than females (n=87) or other genders (n=7) dropped out of the study prior to completion ($X^2= 61.23$, $p < .0001$).

Sub-sample analysis by country

United Kingdom (UK)

In the UK, the change in problem drinking severity (AUDIT-C) was 1.05 ± 1.46 [CI: 0.91-1.19] (range: 0-8), and the mean change in the amount consumed was 5.93 ± 11.75 [CI: 4.82-7.05], units per week (range: 0-120). Current problem drinking severity (full AUDIT) was 4.09 ± 4.94 [CI: 3.62-4.56] (range: 0-27). Of the subjects who reported they consume alcohol (n=434), the change in severity from pre-quarantine to quarantine was a decrease of -0.16 ± 2.15 , [CI: -0.3-0.06] (range -8-6) but not significantly so ($U= -1.38$, [CI: 0.01-0.89] $p= .19$). The units of

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3 alcohol consumed per week was significantly increased during the quarantine period ($11.25 \pm$
4 17.73 units, [CI: 9.36-13.13] range= 1-120) compared to November (10.94 ± 14.17 units, [CI:
5 $9.44-12.45$] range = 0-150), $U= 3.0$, [CI: 0-0.7] $p= .003$. Further, 60 (14%) subjects reported
6 abstention from alcohol consumption during the quarantine period. More subjects reported a
7 decrease (n= 151, 43%) or an increase (n= 130, 39%) as opposed to no change (n= 61, 18%) of
8 weekly alcohol consumption from November to the quarantine period ($X^2= 7.2$, $p = .007$). The
9 Oxford COVID-19 Government Response Tracker [24] at the country level indicated that the
10 lockdown stringency index in the UK during data collection (05/12/2020 to 05/28/2020) was
11 88.89, with 15,684 confirmed cases and 488 deaths.
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20 United States (US)

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23 In the US, change in problem drinking severity (AUDIT-C) was 1.01 ± 1.55 units [CI: 0.85-1.17]
24 (range: 0-8), and the mean change in the amount consumed was 3 ± 5.51 [CI: 2.39-4] units per
25 week (range: 0-34). The current problem drinking severity (full AUDIT) was 3.48 ± 4.95 [CI: 3-
26 4] (range: 0-32). Of the subjects who reported they consume alcohol (n= 353), the change in
27 severity from pre-quarantine to quarantine was a decrease of -0.11 ± 2.42 [CI: -0.43-0.21], range
28 -8-8 ($U= -0.66$, [CI: 0.05-0.9] $p= .51$), but not significantly so. The units of alcohol consumed
29 per week increased between the quarantine period (7.39 ± 11.45 units, [CI: 5.88-8.9] range= 0-
30 80) and November (6.93 ± 9.78 units, [CI: 5.88-8.9] range = 0-96), but not significantly so ($U= -$
31 1.1 , [CI: 0.01-0.94] $p= .29$). Further, 44 (13%) subjects reported abstention from alcohol
32 consumption during the quarantine period. More subjects reported a decrease (n= 90, 41%) or an
33 increase (n= 88, 40%) as opposed to no change (n= 45, 21%) of weekly alcohol consumption
34 from November to the quarantine period ($X^2= 8.15$, $p = .004$). The Oxford COVID-19
35 Government Response Tracker [24] at the country level indicated that the lockdown stringency
36 index in the US during data collection (05/12/2020 to 05/28/2020) was 70.92, with 1,347,916
37 confirmed cases and 80,684 deaths.
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50 Canada

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53 In Canada, change in problem drinking severity (AUDIT-C) was 0.67 ± 1.45 [CI: 0.31-1.03]
54 (range: 0-8), and the mean change in the amount consumed was 3.03 ± 7.45 [CI: 1.17-4.89] units
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per week (range: 0-49). The current problem drinking severity (full AUDIT) was 2.78 ± 4.24 [CI: 1.7-3.85] (range: 0-24). Of the subjects who reported they consume alcohol (n= 35), the change in severity from pre-quarantine to quarantine was an increase of 0.16 ± 2.2 , [CI: -0.62-0.95](range= -8-5), but not significantly so (U= .77, [CI: 0.03-0.98] $p= .44$). The units of alcohol consumed per week was decreased during the quarantine period (8.03 ± 14.22 units, [CI:] range= 0-50) and November (6.71 ± 9.49 units, [CI: 3.46-9.97] range = 0-25), although not significantly so (U= 0.17, [CI: 0.59-1.0] $p= .86$). Further, 4 (12%) subjects reported abstention from alcohol consumption during the quarantine period. More subjects reported an increase (n= 16, 46%) as opposed to a decrease (n= 10, 29%) or no change (n= 9, 26%) of weekly alcohol consumption from November to the quarantine period, although not significantly so ($X^2= 0.03$, $p= .85$). The Oxford COVID-19 Government Response Tracker [24] at the country level indicated that the lockdown stringency index in Canada during data collection (05/12/2020 to 05/28/2020) was 70.83, with 69,981 confirmed cases and 4,993 deaths.

Sub-sample analysis by gender

Males

For the males in our sample (n=1,000), the change in problem drinking severity (AUDIT-C) was in 0.91 ± 1.53 [CI: 0.82-1.01] (range: 0-8) and the mean change in the amount consumed was 3.88 ± 8.84 [CI: 3.33-4.42] units per week (range: 0-120). The current problem drinking severity (full AUDIT) was 2.99 ± 4.61 [CI: 2.71-3.28] (range: 0-32), with 403 males included that do not consume alcohol. Of males who reported they consume alcohol (n= 597), the change in severity from pre-quarantine to quarantine was a decrease of -0.4 ± 2.4 , [CI: -0.5- -0.21] range -8-8 (U= -3.57, [CI: 0.0-0.03] $p < .0001$). The units of alcohol consumed per week was significantly decreased during the quarantine period (8.52 ± 14 units, [CI: 7.33-9.71] range= 0-120) compared to November (9.23 ± 12.62 units, [CI: 8.21-10.24] range = 0-120), U= -5.2, [CI: 0.0-0.13] $p < .0001$. Further, 128 (20%) males reported abstention from alcohol consumption during the quarantine period. More males reported a decrease (n= 278, 47%) or an increase (n= 204, 34%) as opposed to no change (n= 115, 19%) of weekly alcohol consumption from November to the quarantine period ($X^2= 15.94$, $p < .0001$).

Females

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5 For females in our sample (n=342), the change in problem drinking severity (AUDIT-C) was
6 0.81 ± 1.1 [CI: 0.69-0.92] (range: 0-8) and the mean change in the amount consumed was $2.82 \pm$
7 4.6 [CI: 2.31-3.32] units per week (range: 0-38). The current problem drinking severity (full
8 AUDIT) was 3.14 ± 4.47 [CI: 3.13-4] (range: 0-21), with 95 females included that do not
9 consume alcohol. Of females who reported they consume alcohol (n= 247), the change in
10 severity from pre-quarantine to quarantine was an increase of 0.12 ± 1.6 , [CI: -0.08-0.32] range -
11 5-8, although not significantly so (U= 1.17, [CI: 0.01-0.93] $p= .24$). The units of alcohol
12 consumed per week was decreased during the quarantine period (6.94 ± 10.62 units, [CI:]
13 range= 0-80) compared to November (6.01 ± 8.08 units, [CI: 5-7.02] range = 0-90), although not
14 significantly so (U= -0.57, [CI: 0.1-0.99] $p= .57$). Further, 43 (17%) females reported abstention
15 from alcohol consumption during the quarantine period. More females reported a decrease (n=
16 102, 41%) or an increase (n= 101, 41%) as opposed to no change (n= 44, 18%) of weekly
17 alcohol consumption from November to the quarantine period ($X^2= 13.46$, $p = .0002$).
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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Page
	Reporting Item	Number
Title and abstract		
Title	#1a Indicate the study's design with a commonly used term in the title or the abstract	1

1	Abstract	#1b	Provide in the abstract an informative and balanced	2
2				
3				
4			summary of what was done and what was found	
5				
6	Introduction			
7				
8				
9				
10	Background /	#2	Explain the scientific background and rationale for the	4
11				
12	rationale		investigation being reported	
13				
14				
15	Objectives	#3	State specific objectives, including any prespecified	5
16				
17			hypotheses	
18				
19				
20	Methods			
21				
22				
23	Study design	#4	Present key elements of study design early in the paper	5
24				
25				
26	Setting	#5	Describe the setting, locations, and relevant dates,	5
27				
28				
29			including periods of recruitment, exposure, follow-up, and	
30				
31			data collection	
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34	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods	5
35				
36			of selection of participants.	
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40		#7	Clearly define all outcomes, exposures, predictors,	6-7
41				
42			potential confounders, and effect modifiers. Give	
43				
44			diagnostic criteria, if applicable	
45				
46				
47	Data sources /	#8	For each variable of interest give sources of data and	6-7
48				
49	measurement		details of methods of assessment (measurement).	
50				
51				
52			Describe comparability of assessment methods if there is	
53				
54			more than one group. Give information separately for for	
55				
56			exposed and unexposed groups if applicable.	
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1	Bias	#9	Describe any efforts to address potential sources of bias	7-8
2				
3				
4	Study size	#10	Explain how the study size was arrived at	7-8
5				
6				
7	Quantitative	#11	Explain how quantitative variables were handled in the	8
8	variables		analyses. If applicable, describe which groupings were	
9			chosen, and why	
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15	Statistical	#12a	Describe all statistical methods, including those used to	8
16	methods		control for confounding	
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20	Statistical	#12b	Describe any methods used to examine subgroups and	8
21	methods		interactions	
22				
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25				
26	Statistical	#12c	Explain how missing data were addressed	7-8
27	methods			
28				
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31	Statistical	#12d	If applicable, describe analytical methods taking account	N/A
32	methods		of sampling strategy	
33				
34				
35				
36	Statistical	#12e	Describe any sensitivity analyses	8
37	methods			
38				
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42	Results			
43				
44				
45	Participants	#13a	Report numbers of individuals at each stage of study—eg	9
46			numbers potentially eligible, examined for eligibility,	
47			confirmed eligible, included in the study, completing	
48			follow-up, and analysed. Give information separately for	
49			for exposed and unexposed groups if applicable.	
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57	Participants	#13b	Give reasons for non-participation at each stage	8
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1	Participants	#13c	Consider use of a flow diagram	N/A- Cross-
2				sectional
3				survey
4				design
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11	Descriptive data	#14a	Give characteristics of study participants (eg	9
12			demographic, clinical, social) and information on	
13			exposures and potential confounders. Give information	
14			separately for exposed and unexposed groups if	
15			applicable.	
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23	Descriptive data	#14b	Indicate number of participants with missing data for	9
24			each variable of interest	
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29	Outcome data	#15	Report numbers of outcome events or summary	N/A- survey
30			measures. Give information separately for exposed and	design
31			unexposed groups if applicable.	
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36	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-	10
37			adjusted estimates and their precision (eg, 95%	
38			confidence interval). Make clear which confounders were	
39			adjusted for and why they were included	
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46	Main results	#16b	Report category boundaries when continuous variables	10
47			were categorized	
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51	Main results	#16c	If relevant, consider translating estimates of relative risk	N/A no risk
52			into absolute risk for a meaningful time period	
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1	Other analyses	#17	Report other analyses done—e.g., analyses of	9, 12
2			subgroups and interactions, and sensitivity analyses	
3				
4				
5				
6	Discussion			
7				
8				
9				
10	Key results	#18	Summarise key results with reference to study objectives	13-15
11				
12				
13	Limitations	#19	Discuss limitations of the study, taking into account	15-16
14			sources of potential bias or imprecision. Discuss both	
15			direction and magnitude of any potential bias.	
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20	Interpretation	#20	Give a cautious overall interpretation considering	13-15
21			objectives, limitations, multiplicity of analyses, results	
22			from similar studies, and other relevant evidence.	
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28	Generalisability	#21	Discuss the generalisability (external validity) of the study	16
29			results	
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32				
33	Other Information			
34				
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36	Funding	#22	Give the source of funding and the role of the funders for	16
37			the present study and, if applicable, for the original study	
38			on which the present article is based	
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Notes:

- 13c: N/A- Cross-sectional survey design
- 15: N/A- survey design
- 16c: N/A no risk The STROBE checklist is distributed under the terms of the Creative Commons Attribution License CC-BY. This checklist was completed on 27. August 2020 using

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