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SM Weerakoon , KK Jetelina & G Knell

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ORIGINAL ARTICLE

Longer time spent at home during COVID-19 pandemic is associated with binge drinking among US adults

SM Weerakoon[a,b], KK Jetelina[a,b], and G Knell[a,b,c]

[a]Department of Epidemiology, Human Genetics, and Environmental Sciences, The University of Texas Health Science Center at Houston (UThealth), Houston, TX, USA; [b]The University of Texas Health Science Center at Houston (UThealth) and Children's Health System of Texas, Dallas, TX, USA; [c]Children's Health Andrews Institute for Orthopaedics and Sports Medicine, Plano, TX, USA

ABSTRACT

Background: The COVID-19 pandemic has introduced and exacerbated stressors (*e.g.*, job loss, poor mental health) for adults across the United States (US) since the first statewide shelter-in-place order on March 19, 2020. Limited research has evaluated if, and how, pandemic-related stressors are associated with changes in alcohol consumption and binge drinking.

Objectives: This analysis aims to identify COVID-19-related stressors associated with changes in alcohol consumption and binge drinking since the outbreak of the coronavirus.

Methods: Data were collected on sociodemographics, alcohol consumption, and COVID-19-related stressors (household composition, job status, essential worker, stay-at-home duration, and depression) using a web-based, self-report survey to US adults from mid-March to mid-April 2020. Multivariable logistic and multinomial regression models were used to assess associations between COVID-19-related stressors and binge drinking and changes in alcohol consumption. Among 1,982 participants, 69% were female and 31% male.

Results: Thirty-four percent of the sample reported binge drinking during the COVID-19 pandemic. More binge drinkers increased alcohol consumption during the pandemic (60%) than non-binge drinkers (28%). After adjusting for sociodemographics, for every 1-week increase in time spent at home during the pandemic, there was 1.21 (95% CI: 1.08–1.35) greater odds of binge drinking. Additionally, binge drinkers with a previous diagnosis of depression and current depression symptoms had greater odds of increased alcohol consumption compared to those reporting no depression (AOR = 1.80, 95% CI: 1.15–2.81).

Conclusion: Specific COVID-19-related stressors are related to alcohol consumption. This highlights the ancillary and unintended effects of the COVID-19 pandemic which could have long-lasting population health consequences.

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Alcohol consumption; shelter-in-place; covid-19; binge drinking; stress

Introduction

Binge drinking is a common but preventable alcohol use behavior defined as having five or more drinks for men or four or more drinks for women in the span of two hours (1,2). A recent systematic review showed that recent and short-term stress is associated with increased heavy alcohol use in men and women (3), while previous research has indicated that life stressors, including work- and family-related stress, can increase the risk of binge drinking among adults (4–6). Among samples of individuals in high-stress situations with sudden environment changes (e.g., college students or members of the armed forces), binge drinking is commonly associated with increased stress levels and has been attributed to decrements in psychological health (7–9). Furthermore, adults with a prior history of alcohol dependence could be triggered into a binge drinking relapse by stressful life events (10).

From January to March 2020, the novel coronavirus SARS-CoV-2, which causes the viral infection COVID-19, quickly spread across the globe leading to what is now known as the COVID-19 pandemic. In response to the outbreak, local and state governments across the United States (US) mandated temporary shelter-in-place and business shutdown policies as an attempt to control and reduce the spread of the virus (11). As a result, US residents experienced sudden loss of salary, employment, physical socialization, and an increase in time spent at home alone or with dependents (12,13), leading to increased stress (14,15). As of late June 2020, 40% of US adults reported struggling with mental health problems, including substance use (16). However, limited research has evaluated the impact of specific COVID-19-related stressors on alcohol consumption, and specifically, binge drinking. One recent study explored the effect of COVID-19 lockdown on alcohol consumption in a sample of participants with

CONTACT SM Weerakoon sitara.m.weerakoon@uth.tmc.edu

preexisting alcohol use disorder in the United Kingdom and another evaluated heavy alcohol consumption in relation to psychological distress following the COVID-19-related closure of a university in northeastern Ohio (17,18). However, no previous studies have explored the relationship among a national US sample.

The present study aimed to identify COVID-19 pandemic-related stressors associated with binge drinking in a sample of adults residing in the US. We hypothesized that alcohol consumption increased during the pandemic compared to before the pandemic. Further, we hypothesized that COVID-19-related stressors were associated with higher odds of alcohol consumption, and specifically among binge drinkers.

Methods

Sample description

From mid-March to mid-April 2020, a web-based, 15-minute, self-report questionnaire was disseminated through the authors' university, department, lab, and private social media accounts (*i.e.*, LinkedIn, Facebook, Twitter, and Instagram) and to relevant e-mail distribution lists (*e.g.*, American Public Health Association, Society of Behavioral Medicine). This study was approved by the Committee for the Protection of Human Subjects review board at UTHealth (IRB number: HSC-SPH -20-0346). Eligible participants were over the age of 18 and residing in the US. Before the start of the survey, interested participants were explained the purpose of the survey, the length of the survey, were informed participation was voluntary, and that they were free to skip any questions they did not wish to answer. The participants must have consented before proceeding to the questions. The survey reached 47,796 social media users and, of the 47,796 reached, 2,790 (5.8%) agreed to participate, 2,766 (99.1%) met the eligibility criteria, and 2,441 (88.3%) participated in the survey. Of the 2,441 total participants, 1,928 responded to a question that indicated their drinking behavior status, which was the final sample size of this study.

Measures

Change in alcohol consumption

All survey participants were asked, "*Compared to life prior to the coronavirus outbreak, how has your consumption of alcohol changed?*" Response items included: (1) drinking the same amount; (2) drinking less alcohol; (3) drinking more alcohol; and (4) I don't drink alcohol.

Binge drinking

If the participant responded to drinking alcohol, they were then asked about drinking behaviors during the pandemic. Binge drinking was defined as having at least five (male)/four (female) alcoholic drinks on one occasion. Responses were divided into three categories: (1) binge drinkers; (2) drinkers that did not report binge drinking (non-binge drinkers); and (3) those that do not drink alcohol (never drinkers).

Independent variables

The following COVID-19-related stressors were recorded within the survey: household composition, job status, essential worker status, shelter-in-place duration, depression prior to the pandemic, and current symptoms of depression.

Household composition included the number of (1) children and (2) adults currently living with the respondent. Adults in household was measured on a discrete scale from zero to 20 while children in household was divided into two categories: (1) zero children and (2) one or more children. We included this predictor because existing evidence has shown an increased number of children contributes to parental stress or strain which might have been exacerbated by COVID-19 (19–21). It was dichotomized because of small sample sizes of responders with two or more children.

Participants were asked if their *job status* had changed as a result of the business lockdown mandates; responses included (1) decreased pay; (2) temporarily laid off; (3) permanently laid off; (4) resigned or quit; (5) forced to use vacation or sick time; (6) other; and (7) no impact. 'Negatively impacted job status' included the first five responses while 'no impact' comprised of the last. 'Other' was excluded since it could not be determined if this was a negative impact. Additionally, participants were asked if they had left their home for any reason. If participants reported the reason was work, they were then asked to report if their job was deemed '*essential*' or '*nonessential*.' A significant proportion (72%) of the sample indicated they did not leave home for work, therefore a third non-response category for 'job considered essential service' was added.

Participants were asked about *shelter-in-place duration*: how much time they had been under lockdown/shelter-in-place policies as well as how much time they spent at home per day. Responses were recorded in (1) total number of weeks and (2) average number of hours per day.

Finally, participants were asked to report symptoms of *depression* since the outbreak of the coronavirus using the validated Patient Health Questionnaire (PHQ)-9 domain (22) and to report previous diagnosis of any

disease or condition (*i.e.*, asthma, heart disease, cancer, lupus, depression). Participants then reported a previous diagnosis of depression, major depression, dysthymia, or minor depression. Summary scores for the PHQ-9 were categorized using clinically relevant cutoff points: (1) no depression symptoms (PHQ-9 range 0–4); (2) mild depression symptoms (PHQ-9 range 5–9); (3) moderate/Severe depression symptoms (PHQ-9 range 10–27) (23). In order to account for previous diagnosis of depression, a new variable was generated to represent the following categories: (0) no previous diagnosis of depression and no current depression symptoms (PHQ-9 range 0–4); (1) no previous diagnosis of depression and current depression symptoms (PHQ-9 range 5–27); (2) previous diagnosis of depression and no current depression symptoms; (3) previous diagnosis of depression and current depression symptoms; and (4) a non-response category due to a significant proportion (52%) of the sample reporting no previous diagnosis of any disease or condition.

Covariates

Covariates included *age* (years), *sex* (Male and Female), and *race/ethnicity* (non-Hispanic [NH] White, NH Black, Hispanic, Asian, Native American, and Other). The sample size for categories other than NH White was small (n = 246), so race/ethnicity was further collapsed into two categories: (1) non-Hispanic White and (2) Other. Participants were asked to report their *annual household income* prior to the pandemic (<$30,000/year; 30,000 USD-$80,000/year; and >$80,000). Income cutoff points were determined using Medicaid expansion guidelines (138% below poverty) and a household size of three people as of 2019 (24). *Education* level consisted of two categories: (1) less than college and (2) college or more. Due to multiple studies showing that there were rural and urban differences in COVID-19 spread during the months of March through April 2020 (25,26), population density characteristics (urban [total population of ZIP code 50,000 or more], suburban [total population of ZIP code between 2,500 and 49,999, and rural [classified as neither urban nor suburban]) was included as a covariate (27).

Statistical analyses

Univariate analyses (*i.e.*, tabulations, frequencies, means, and standard deviation [SD]) were used to describe the sample. Student's *t*-tests, Chi-square tests, and median tests were used to evaluate bivariate associations between binge drinking (dependent variables) and demographics/stressors (independent variables). Multivariable logistic regression models evaluated the associations between COVID-19-related stressors (independent variables) and binge drinking ([0] = non-binge drinkers and [1] = binge drinkers) separately, while adjusting for sociodemographics. In addition, multivariable multinomial regression models were used to assess the associations between COVID-19-related stressors (independent variables) and change in alcohol consumption (dependent variable; [1] = Drinking more alcohol; [2] = drinking less alcohol; [3] = drinking about the same [referent]) among binge drinkers. Multinomial logistic regression models were implemented because the dependent variable had more than two categories; a multinomial logistic regression calculates a ratio of odds of each subcategory to the identified referent group (i.e., drinking about the same) (28). All analyses were performed using Stata statistical software version 15.1 (College Station, TX).

Results

Table 1 describes the sample population. Participants who participated in the survey were, on average, 42 years (SD = 13.6), 31% male, 89% NH White, and 75% reported a household income of more than 80,000 USD/year (prior to the pandemic). Additionally, 42% of the sample reported living in an urban area. Among the total sample, the median number of adults living in household was two, 58% had no children living in household, 88% reported that their job status was not impacted by the pandemic, and 19% reported that their job was considered an essential service. All participants reported sheltering-in-place for an average of 4 weeks (SD = 1.0). Participants reported that they spent 21 out of 24 hours at home, and 27% reported a previous diagnosis of depression and current depression symptoms.

Table 1 also displays demographics stratified by binge drinking status during the pandemic. Binge drinkers were significantly different from non-binge drinkers and never drinkers across all sociodemographic variables. Binge drinkers were more likely to increase alcohol consumption during the pandemic (compared to before the pandemic; 60%) than non-binge drinkers (28%). Among COVID-19-related stressors, there were statistically significant differences found in the number of adults in the household, the number of children in household, and depression during pandemic across binge drinking status.

Table 2 displays the bivariate and multivariable odds of binge drinking during the pandemic (compared to non-binge drinkers) across COVID-19-related stressors. After adjusting for sociodemographics, for every one-week increase in time spent under a shelter-in-place order there was a 1.19 (95% Confidence Interval [CI]:

Table 1. Sample description, March – April 2020 (N = 1,928).

	Total sample 1,928 (100)	Drinking status, N (%) Binge drinkers* 664 (34.4)	Non-binge drinkers 837 (43.4)	Never drinkers 427 (22.1)	*p* value
Sociodemographics					
Age (years)					0.01
Mean (SD)	42.1 (13.6)	39.3 (11.9)	43.4 (13.4)	44.1 (15.5)	
Sex					<0.01
Male	604 (31.3)	272 (41.0)	220 (26.7)	112 (26.3)	
Female	1,323 (68.7)	392 (59.0)	617 (73.7)	314 (73.7)	
Race/ethnicity					<0.01
NH White	1,695 (88.6)	596 (90.2)	751 (90.4)	348 (82.5)	
Other	219 (11.4)	65 (9.8)	80 (9.6)	74 (17.5)	
Household income prior to pandemic					<0.01
<$30 k/year	97 (5.1)	34 (5.2)	31 (3.8)	32 (7.8)	
$30 k-$80 k/year	384 (20.3)	125 (19.0)	145 (17.7)	114 (27.6)	
>$80 k/year	1,411 (74.6)	500 (75.8)	645 (78.5)	266 (64.6)	
Education					<0.01
College or more	1,606 (83.5)	551 (83.2)	726 (87.0)	329 (77.2)	
Less than college	317 (16.5)	111 (16.8)	109 (13.0)	97 (22.8)	
Urbanicity					<0.01
Rural	432 (24.4)	128 (21.2)	197 (25.4)	107 (27.3)	
Suburban	585 (33.0)	176 (29.2)	275 (35.5)	134 (34.2)	
Urban	753 (42.5)	299 (49.6)	303 (39.1)	151 (38.5)	
Alcohol Consumption					
Change during pandemic					<0.01
Drinking about the same	674 (34.9)	207 (31.1)	467 (55.8)	-	
Drinking more alcohol	630 (32.2)	398 (60.0)	232 (27.7)	-	
Drinking less alcohol	197 (10.2)	59 (8.9)	138 (16.5)	-	
Never drinkers	427 (22.1)	-	-	427 (22.1)	
Maximum number of drinks on any occasion since pandemic (mean (SD))					
Number of drinks	-	6.5 (3.2)	2.1 (1.1)	-	<0.01
Average number of drinks on any occasion since pandemic (mean (SD))					
Number of drinks	-	3.6 (2.1)	1.5 (1.0)	-	<0.01
COVID-19-related stressors					
# Adults in household					0.01
Median (IQR)	2.0 (2.0–2.0)	2.0 (2.0–2.0)	2.0 (1.0–3.0)	2.0 (2.0–2.0)	
# Children in household					
None	1,077 (56.8)	394 (60.2)	434 (52.7)	249 (59.3)	<0.01
1 +	820 (43.2)	260 (39.8)	389 (47.3)	171 (40.7)	
Job status impact					0.09
Not impacted	1,689 (87.6)	569 (85.7)	735 (87.8)	385 (90.2)	
Negatively impacted	239 (12.4)	95 (14.3)	102 (12.2)	42 (9.8)	
Essential service job[±]					0.02
Essential	444 (23.0)	174 (26.2)	181 (21.6)	89 (20.8)	
Non-essential	105 (5.5)	45 (6.7)	41 (4.9)	19 (4.5)	
Non-response	1,379 (71.5)	445 (67.0)	615 (73.5)	319 (74.7)	
Local shelter-in-place duration (weeks)					0.65
Mean (SD)	3.8 (1.0)	3.9 (1.0)	3.8 (0.9)	3.8 (1.1)	
Time spent at home per day (hours)					0.25
Mean (SD)	21.4 (3.7)	21.2 (3.7)	21.6 (3.6)	21.4 (4.0)	
Depression before and during pandemic[§]					<0.01
No previous diagnosis, no current symptoms	211 (10.9)	56 (8.4)	103 (12.3)	52 (12.2)	
No previous diagnosis, current symptoms	133 (6.9)	42 (6.3)	59 (7.1)	32 (7.5)	
Previous diagnosis, no current symptoms	46 (2.4)	14 (2.1)	25 (3.0)	7 (2.6)	
Previous diagnosis, current symptoms	527 (27.3)	211 (31.8)	197 (23.5)	119 (28.9)	
Non-response	1,011 (52.4)	341 (51.4)	453 (54.1)	217 (50.8)	

Abbreviations: IQR, interquartile range; NH, non-Hispanic; SD, standard deviation.

Notes: * Binge drinker was defined as having five or more drinks on one occasion if participant was male or four or more drinks on one occasion if participant was female. [‡]The question on essential job status was prompted after participants responded affirmatively that they left home for work during the shelter-in-place order; 1,379 participants did not receive the essential job status question since they indicated they had not left home for work. [§]The question on previous diagnosis of depression was prompted after participants reported a previous diagnosis of any disease or condition (*i.e.*, asthma, heart disease, cancer, lupus, depression); 1,011 participants did not receive the depressive disorder question since they indicated no previous diagnosis of any disease or condition.

1.06–1.34) greater odds of binge drinking. Households with children had 0.74 lower odds of binge drinking during the pandemic compared to households with no children (Adjusted Odds Ratio [AOR]: 0.74, 95% CI: 0.58–0.94). Additionally, those who reported a previous diagnosis of depression and mild and moderate/severe depressive symptoms during the pandemic had greater odds of binge drinking compared to those

Table 2. Bivariate and multivariable^ odds of binge drinking* during the pandemic among a sample of US residents that report drinking alcohol (N = 1,501).

	Binge drinking+	
	Bivariate OR (95% CI)	Multivariable^OR (95% CI)
COVID-19-related stressors		
# Adults in household	0.95 (0.87, 1.04)	0.97 (0.87, 1.07)
# Children in household		
None	Ref.	Ref.
1+	**0.73 (0.60, 0.91)**	**0.74 (0.58, 0.94)**
Job status impact		
Not impacted	Ref.	Ref.
Negatively impacted	1.20 (0.89, 1.62)	1.16 (0.84, 1.62)
Job considered essential service		
Essential	Ref.	Ref.
Non-essential	1.14 (0.71, 1.83)	0.93 (0.56, 1.54)
Non-response	**0.75 (0.59, 0.96)**	0.82 (0.63, 1.07)
Local shelter-in-place duration (weeks)	**1.19 (1.07, 1.33)**	**1.19 (1.06, 1.34)**
Time spent at home (hours)	**0.96 (0.94, 0.99)**	0.98 (0.95, 1.01)
Depression before and during pandemic		
No previous diagnosis, no current symptoms	Ref.	Ref.
No previous diagnosis, current symptoms	1.31 (0.78, 2.18)	1.40 (0.80, 2.44)
Previous diagnosis, no current symptoms	1.03 (0.50, 2.14)	1.20 (0.54, 2.66)
Previous diagnosis, current symptoms	**1.97 (1.35, 2.88)**	**1.77 (1.16, 2.73)**
Non-response	0.38 (0.97, 1.97)	1.16 (0.79, 1.73)

Abbreviations: OR, odds ratio; CI: confidence interval
+Compared to non-binge drinking
Notes: * Binge drinking was defined as having five or more drinks on one occasion if participant was male or four or more drinks on one occasion if participant was female; ^ Separate models for each stressor and adjusted for age, sex, race, income, education level, and population density characteristics.

reporting no previous diagnosis of depression and no depression during the pandemic (AOR = 1.80, 95% CI: 1.15–2.81).

Table 3 displays the multivariable relative odds ratios of increased and decreased alcohol consumption compared to no change in alcohol consumption across COVID-19 stressors among binge drinkers. The odds of increased alcohol consumption among binge drinkers was significantly higher among participants reporting previous diagnosis of depression and current depressive symptoms (compared no diagnosis of depression and no current symptoms; AOR = 3.37, 95% CI: 1.67, 6.81) and

Table 3. Multivariable^ odds of change in alcohol consumption during the pandemic among binge drinkers* (N = 664).

	Change in alcohol consumption+	
	Decrease OR (95% CI)	Increase OR (95% CI)
COVID-19-related stressors		
# Adults in household	1.14 (0.97, 1.35)	0.92 (0.80, 1.07)
# Children in household		
None	Ref.	Ref.
1+	0.74 (0.34, 1.59)	1.33 (0.90, 1.97)
Job status impact		
Not impacted	Ref.	Ref.
Negatively impacted	0.83 (0.29, 2.42)	1.54 (0.90, 2.62)
Job considered essential service		
Essential	Ref.	Ref.
Non-essential	1.18 (0.26, 5.38)	1.27 (0.57, 2.87)
Non-response	1.55 (0.70, 3.48)	0.99 (0.65, 1.51)
Local stay-at-home order duration (weeks)	1.29 (0.95, 1.76)	0.90 (0.74, 1.09)
Time spent at home (hours)	1.03 (0.94, 1.13)	1.03 (0.98, 1.08)
Depression before and during pandemic		
No previous diagnosis, no current symptoms	Ref.	Ref.
No previous diagnosis, current symptoms	1.47 (0.26, 8.27)	2.34 (0.93, 5.93)
Previous diagnosis, no current symptoms	0.31 (0.03, 3.42)	0.19 (0.04, 0.99)
Previous diagnosis, current symptoms	0.78 (0.20, 2.95)	**3.37 (1.67, 6.81)**
Non-response	0.99 (0.30, 3.33)	1.63 (0.86, 3.11)

Abbreviations: OR, odds ratio; CI: confidence interval
+In relation to no change in alcohol consumption during the pandemic
Notes: ^ Separate models for each stressor and adjusted for age, sex, race, income, education level, and population density characteristics; * Binge drinking was defined as having five or more drinks on one occasion if participant was male or four or more drinks on one occasion if participant was female.

among households with children; however, this was not statistically significant (compared to no children; AOR = 1.33, 95% CI: 0.90–1.97).

Discussion

This study is the first to identify specific stressors associated with binge drinking, and increased alcohol consumption among binge drinkers, during the COVID-19 pandemic. Overall, we found that binge drinkers increased their alcohol consumption during the early stages of the pandemic, while the majority of non-binge drinkers drank about the same during this period. There were two COVID-19-related stressors associated with increased consumption among binge drinkers during the pandemic: (1) length of time spent under a shelter-in-place order and (2) previous diagnosis of depression and current depressive symptoms. This is consistent with prior research, indicating that increased time spent at home is a life stressor that impacts drinking and that the COVID-19 pandemic may have exacerbated this stress (4,17). Additionally, future research should consider the potential for depressive symptoms acting as a moderator in the relation between the time spent under a shelter-in-place mandate and binge drinking, given that increased length of shelter-in-place could result in increased depressive symptoms (29).

Interestingly, and contrary to our hypotheses, living with children was associated with lower odds of binge drinking during the pandemic. This is consistent with a past study among a sample of Chinese survey participants that found lower odds of drinking among men and women living with a spouse and a child, compared with living alone (30). The authors hypothesized that living with others can contain and control unhealthy behaviors. More research is needed to unravel this relationship, as the majority of research has explored the proposed relationship in the context of child abuse or child health (31,32).

It is important to note the relatively high socioeconomic status (SES) of our sample. Over 70% of respondents reported an annual income of greater than 80,000, USD which potentially indicates more disposable income. Hazardous alcohol use has been associated with higher income (33). In addition, in April 2020, Forbes reported that wine and spirits sales had increased by 55% in the United States (34). It is possible that due to this high SES population, alcohol consumption is overestimated compared to the general population. Future research is needed for a larger, more generalizable population so these specific relationships can be further explored.

Given the ever-evolving pandemic, the findings of this study may differ as time progressed. For example, individuals may have adapted to the "new normal" and maintained pre-pandemic alcohol consumption behaviors. Previous research has shown that groups of people experiencing high stress (*e.g.*, refugees and victims of natural disaster) develop resilience in the face of accumulating trauma and are able to develop mechanisms to sustain healthier behaviors in the long term (35,36), indicating the potential to maintain prepandemic alcohol consumption behaviors or improve upon this behavior and consume less. On the other hand, others may feel increasingly strained due to the length of stress endured and changes experienced which may lead to an increased dependence on alcohol (37). Future studies should utilize a longitudinal design to evaluate how alcohol consumption may have changed over time.

The ensuing behaviors during the COVID-19 pandemic may be long-lasting. Studies have shown that engaging in binge drinking behavior can lead to long-term alcohol use disorders and alcohol dependence (38–40). Heavy alcohol consumption is known to be associated with liver diseases, cancers, and cardiovascular disease risk (41,42), which increases mortality rates and brings upon significant social and economic loss to society. Given the potential for future shelter-in-place mandates as the pandemic continues, future research should aim to develop strategies to prevent and intervene on binge drinking behaviors while people are in isolation. For example, previous studies have highlighted the effectiveness of virtual (e.g., texting- and mobile application-based) interventions to reduce binge drinking behaviors in adults, ideal for implementation in a pandemic setting (43,44).

Finally, regarding the COVID-19 pandemic, a National Institute of Health (NIH)-funded study recently found that people with substance use disorders (SUDs) are more likely to develop COVID-19 and experience worse COVID-19-related outcomes compared to those without SUDs (45). In light of the variety of detrimental effects of the COVID-19 pandemic, additional research is needed to develop best treatment for people with substance use disorders who may be more susceptible to adverse health outcomes.

Limitations

The results of this study should be considered in light of several limitations. First, the data collected were self-reported, which is prone to error due to social desirability bias (46). Second, a response rate of 5.8% may be low compared to other traditional forms of participant

recruitment (47), however, it is similar to other studies utilizing social media for participant recruitment prior to (48) and during the COVID-19 pandemic (49). Additionally, it is important to note that our completion rate, or the proportion of participants who completed the survey after clicking on the link, was 87.5% (2441/2790). This estimate is higher (21–26%) than what has previously been reported by studies utilizing social media recruitment strategies (50). Third, the question used to classify binge drinking lacked a specified length of time the alcohol was consumed within, as it is defined elsewhere (2). This discrepancy in the definition of binge drinking could have introduced bias into the classification of the outcome. The cross-sectional design of this study limited our ability to determine binge-drinking behaviors before the pandemic. However, we included self-reported changes in alcohol consumption prior, which offers some insight into how drinking behaviors among this group may have changed. Finally, this sample is not representative of the US; therefore, the findings may not be generalized to the larger population.

Conclusions

The findings of this study indicate that COVID-19 stressors are related to alcohol consumption and binge drinking among adults residing in the US. This highlights the need to consider the ancillary, and potentially unintended health effects of the COVID-19 pandemic, which could have long-lasting population health consequences. Future research should aim to adapt and implement innovative efforts to mitigate binge drinking, and other potential negative health behaviors, while adults are isolated at home.

References

1. Centers for Disease Control and Prevention (CDC). Binge drinking. 2019; [accessed 2020 Sep]. https://www.cdc.gov/alcohol/fact-sheets/binge-drinking.htm
2. National Institues of Health (NIH). NIaaa council approves definition of binge drinking. *NIAAA Newsletter, 3*. 2004
3. Stanesby O, Labhart F, Dietze P, Wright C, Kuntsche E. The contexts of heavy drinking: A systematic review of the combinations of context-related factors associated with heavy drinking occasions. Plos One. 2019;14:e0218465. doi:10.1371/journal.pone.0218465.
4. Grzywacz J, Almeida DM. Stress and binge drinking: A daily process examination of stressor pile-up and socioeconomic status in affect regulation. Int J Stress Manag. 2008;14:364–80. doi:10.1037/a0013368.
5. Sacco P.Taking the edge off: the role of stressful events and perceived stress on alcohol use and problems among older adults. Washigton University in St. Louis, All Theses and Dissertations (ETDs), 303. 2009.
6. Sacco P, Bucholz KK, Harrington D. Gender differences in stressful life events, social support, perceived stress, and alcohol use among older adults: results from a national survey. Subst Use Misuse. 2014;49:456–65. doi:10.3109/10826084.2013.846379.
7. Chen Y, Feeley TH. Predicting binge drinking in college students: rational beliefs, stress, or loneliness? J Drug Educ. 2015;45:133–35. doi:10.1177/0047237916639812.
8. Pedersen DE. Which stressors increase the odds of college binge drinking? Coll Stud J. 2017;51:129–41.
9. Ursano RJ, Wang J, Ramsawh H, Russell D, Benfer N, Gifford RK, Cohen GH, Galea S, Fullerton CS. Post-traumatic stress disorder, depression, and binge drinking in the reserve component of the US armed forces. Mil Med. 2016;181:1287–93. doi:10.7205/MILMED-D-15-00445.
10. Pilowsky D, Keyes KM, Geier TJ, Grant BF, Hasin DS. Stressful life events and relapse among formerly alcohol dependent adults. Soc Work Ment Health. 2013;11:184–97. doi:10.1080/15332985.2012.711278.
11. Schumaker E. Here are the states that have shut down nonessential businesses. *ABCNews*. 2020 Apr 3. https://abcnews.go.com/Health/states-shut-essential-businesses-map/story?id=69770806
12. Parker KJ. About half of lower-income americans report household job or wage loss due to COVID-19. Pew Research Center. 2020. https://www.pewsocialtrends.org/2020/04/21/about-half-of-lower-income-americans-report-household-job-or-wage-loss-due-to-covid-19/
13. Pinsker J. The art of socializing during a quarantine. *The Atlantic*. 2020 Mar 13. https://www.theatlantic.com/family/archive/2020/03/coronavirus-quarantine-socializing/608020/
14. Louie D. How are Millennials, Gen-Z, Boomers coping with COVID-19 stress? Surprising survey results here. *ABCNews*. 2020 Jul 30. https://abc7news.com/coronavirus-mental-health-millennials-gen-z/6343589/
15. Patrick S, Henkhaus LE, Zickafoose JS, Lovell K, Halvorson A, Loch S, Letterie M, Davis MM. Well-being of parents and children during the COVID19 pandemic: A national survey. Pediatrics. 2020;146:e2020016824. doi:10.1542/peds.2020-016824.
16. Czeisler MÉ, Lane RI, Petrosky E, Wiley JF, Christensen A, Njai R, Weaver M, Robbins R, Facer-Childs ER, Barger LK, et al. Mental health, substance use, and suicidal ideation during the COVID-19 Pandemic — United States, June 24–30, 2020. Morbidity Mortality Weekly Rep. 2020;69:1049–57. doi:10.15585/mmwr.mm6932a1.
17. Kim JU, Majid A, Judge R, Crook P, Nathwani R, Selvapatt N, Lovendoski J, Manousou P, Thursz M, Dhar A, et al. Effect of COVID-19 lockdown on alcohol consumption in patients with pre-existing alcohol use disorder. Lancet Gastroenterol Hepatol. 2020;5:886–87. doi:10.1016/S2468-1253(20)30251-X.
18. Lechner WV, Laurene KR, Patel S, Anderson M, Grega C, Kenne DR. Changes in alcohol use as a function of psychological distress and social support following COVID-19 related University closings. Addict Behav. 2020;110:106527. doi:10.1016/j.addbeh.2020.106527.

19. Chan YC. Parenting stress and social support of mothers who physically abuse their children in Hong Kong. Child Abuse Negl. 1994;18:261–69. doi:10.1016/0145-2134(94)90110-4.
20. Mikolajczak M, Raes ME, Avalosse H, Roskam I. Exhausted parents: sociodemographic, child-related, parent-related, parenting and family-functioning correlates of parental burnout. J Child Fam Stud. 2018;27:602–14.
21. Östberg M, Hagekull B. A structural modeling approach to the understanding of parenting stress. J Clin Child Psychol. 2000;29:615–25. doi:10.1207/S15374424JCCP2904_13.
22. Spitzer R, Kroenke K, JBW W; the Patient Health Questionnaire Primary Care Study Group. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. JAMA. 1999;282:1737–44.
23. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001;16:606–13. doi:10.1046/j.1525-1497.2001.016009606.x.
24. United States (U.S.) Centers for Medicare & Medicaid Services. Federal poverty level (FPL). 2019; [accessed 2020 Sep]. https://www.healthcare.gov/glossary/federal-poverty-level-fpl/
25. Jones B. Urban residents in states hit hard by COVID-19 most likely to see it as a threat to daily life. Pew Research Center. 2020 Mar 30; [accessed 2020 Sep]. https://www.pewresearch.org/fact-tank/2020/03/20/urban-residents-in-states-hit-hard-by-covid-19-most-likely-to-see-it-as-a-threat-to-daily-life/
26. Ranscombe P. Rural areas at risk during COVID-19 pandemic. Lancet Infect Dis. 2020;20:545. doi:10.1016/S1473-3099(20)30301-7.
27. United States (U.S.) Census Bureau. 2010 census urban and rural classification and urban area criteria. n.d.; [accessed 2020 Sep]. https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/2010-urban-rural.html
28. Bayaga A. Multinomial logistic regression: usage and application in risk analysis. J Appl Quan Methods. 2010;5:288–296.
29. Panchal N, Kamal R, Orgera K, Cox C, Garfield R, Hamel L, Munana C, Chidambaram P. The implications of COVID-19 for mental health and substance use. Kaiser Family Foundation. 2020 Aug 21; [accessed 2020 Sep]. https://www.kff.org/coronavirus-covid-19/issue-brief/the-implications-of-covid-19-for-mental-health-and-substance-use/
30. Zhang J, Wu L. Cigarette smoking and alcohol consumption among chinese older adults: do living arrangements matter? Int J Environ Res Public Health. 2015;12:2411–36. doi:10.3390/ijerph120302411.
31. Keyes KM, Hatzenbuehler ML, Hasin DS. Stressful life experiences, alcohol consumption, and alcohol use disorders: the epidemiologic evidence for four main types of stressors. Psychopharmacology. 2011;218:1–17.
32. Manning V, Best DW, Faulkner N, Titherington E. New estimates of the number of children living with substance misusing parents: results from UK national household surveys. BMC Public Health. 2009;9:377. doi:10.1186/1471-2458-9-377.
33. Keyes KM, Hasin DS. Socio-economic status and problem alcohol use: the positive relationship between income and the DSM-IV alcohol abuse diagnosis. Addiction. 2008;103:1120–30. doi:10.1111/j.1360-0443.2008.02218.x.
34. Micallef J. How the COVID-19 pandemic is upending the alcoholic beverage industry. Forbes; 2020 Apr 4; [accessed 2020 Sep]. https://www.forbes.com/sites/joemicallef/2020/04/04/how-the-covid-19-pandemic-is-upending-the-alcoholic-beverage-industry/#19d0bc994b0b
35. Osman-Elasha B, Goutbi N, Spanger-Siegfried E, Dougherty B, Hanafi A, Zakieldeen S, Sanjak A, Atti HA, Elhassan HM (2006). Adaptation strategies to increase human resilience against climate variability and change: lessons from the arid regions of Sudan. *Assessments of Impacts and Adaptations to Climate Change (AIACC) Working Paper, 42*.
36. Silove D. Forced migration and mental health: rethinking the care of refugees and displaced persons. In: Ingleby D, editor. From trauma to survival and adaptation. New York: Springer US; 2005. p. 29–51.
37. Keyes KM, Hatzenbuehler ML, Grant BF, Hasin DS. Stress and alcohol: epidemiologic evidence. Alcohol Res Curr Rev. 2012;34:391–400.
38. Jennison KM. The short-term effects and unintended long-term consequences of binge drinking in college: a 10-year follow-up study. Am J Drug Alcohol Abuse. 2004;30:659–84.
39. Kuntsche E, Kuntsche S, Thrul J, Gmel G. Binge drinking: health impact, prevalence, correlates and interventions. Psychol Health Affairs. 2017;32:976–1017. doi:10.1080/08870446.2017.1325889.
40. Rubinsky AD, Dawson DA, Williams EC, Kivlahan DR, Bradley KA. AUDIT-C scores as a scaled marker of mean daily drinking, alcohol use disorder severity, and probability of alcohol dependence in a US general population sample of drinkers. Alcohol Clin Exp Res. 2013;37:1380–90. doi:10.1111/acer.12092.
41. Fuster D, Samet JH. Alcohol use in patients with chronic liver disease. N Engl J Med. 2018;379:1251–61. doi:10.1056/NEJMra1715733.
42. Sánchez-Jiménez BA, Brizuela-Alcántara D, Ramos-Ostos MH, Alva-López LF, Uribe-Esquivel M, Chávez-Tapia NC. Both alcoholic and non-alcoholic steatohepatitis association with cardiovascular risk and liver fibrosis. Alcohol. 2018;69:63–67. doi:10.1016/j.alcohol.2017.11.004.
43. Carrà G, Crocamo C, Bartoli F, Carretta D, Schivalocchi A, Bebbington PE, Clerici M. Impact of a mobile E-Health intervention on binge drinking in young people: the digital–alcohol risk alertness notifying network for adolescents and young adults project. J Adolesc Health. 2016;58:520–26. doi:10.1016/j.jadohealth.2016.01.008.
44. Suffoletto B, Kristan J, Chung T, Jeong K, Fabio A, Monti P, Clark DB. An interactive text message intervention to reduce binge drinking in young adults: a randomized controlled trial with 9-month outcomes. Plos One. 2015;10:e0142877. doi:10.1371/journal.pone.0142877.
45. National Institutes of Health (NIH). Substance use disorders linked to COVID-19 susceptibility. 2020;

[accessed 2020 Sep]. https://www.nih.gov/news-events/news-releases/substance-use-disorders-linked-covid-19-susceptibility

46. Althubaiti A. Information bias in health research: definition, pitfalls, and adjustment methods. J Multidiscip Healthcare. 2016;9:211–17. doi:10.2147/JMDH.S104807.
47. Blumenberg C, Barros AJ. Response rate differences between web and alternative data collection methods for public health research: a systematic review of the literature. Int J Public Health. 2018;63:765–73.
48. So R, Shinohara K, Aoki T, Tsujimoto Y, Suganuma AM, Furukawa TA. Effect of recruitment methods on response rate in a web-based study for primary care physicians: factorial randomized controlled trial. J Med Internet Res. 2018;20:e28. doi:10.2196/jmir.8561.
49. Ali SH, Foreman J, Capasso A, Jones AM, Tozan Y, DiClemente RJ. Social media as a recruitment platform for a nationwide online survey of COVID-19 knowledge, beliefs, and practices in the United States: methodology and feasibility analysis. BMC Med Res Methodol. 2020;20:1–11. doi:10.1186/s12874-020-01011-0.
50. McRobert CJ, Hill JC, Smale T, Hay EM, van der Windt DA. A multi-modal recruitment strategy using social media and internet-mediated methods to recruit a multidisciplinary, international sample of clinicians to an online research study. PloS One. 2018;13:e0200184. doi:10.1371/journal.pone.0200184.