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Mental health and economic stressors associated with high-risk drinking and increased alcohol consumption early in the COVID-19 pandemic in the United States

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ABSTRACT

Physical distancing measures to curb COVID-19 transmission introduced mental health and economic stressors, possibly impacting problematic drinking. This cross-sectional study examines mental health and economic stressors early in the COVID-19 pandemic which may be associated with heavy alcohol use and increased alcohol use. We administered an online survey of U.S. adults via social media April 5 to May 5, 2020. High-risk drinking was defined by WHO risk drinking levels, a daily average of ≥4 drinks for men and ≥3 drinks for women. Participants reported retrospective assessments of increased alcohol use if their past-week alcohol consumption exceeded their past-year average weekly alcohol consumption. We used logistic regression to assess possible covariates of high-risk drinking and increased alcohol use. Among 2175 participants, 10% (n = 222) reported high-risk drinking, and 36% (n = 775) reported increased alcohol consumption. In multivariable analysis, high-risk drinking was significantly associated with household job loss (OR = 1.41, 95%CI = (1.06, 1.88)) and depressive symptoms (OR = 1.05, 95% CI = (1.02, 1.07)), and women had higher odds of high-risk drinking than men (OR = 2.37, 95% CI = (1.32, 4.69)). Previous mental health diagnosis was not significantly associated with high-risk drinking during the pandemic (OR = 1.31, 95% CI = (0.98, 1.76)) in univariable analysis. High-risk drinkers were almost six times as likely to report retrospective assessments of increased alcohol consumption, controlling for mental health and economic stressors (OR = 5.97, 95% CI = (4.35, 8.32)). Findings suggest a need for targeted interventions to address the complex mental health and economic stressors that may increase alcohol consumption and high-risk drinking during and after the pandemic.

1. Introduction

In the United States, the SARS-CoV-2 (COVID-19) pandemic—and necessary measures to control disease transmission—have given rise to several unintended mental health consequences, including increased rates of anxiety, depression, and loneliness stemming from social isolation; economic strain from reduced work hours and job loss; stress related to fear of disease transmission; and uncertainty about the future (McGinty et al., 2020; Czeisler et al., 2020; Holingue et al., 2020). Studies prior to the pandemic have shown that mental health problems such as stress, anxiety, and mood disorders have been linked to increased alcohol consumption (Smith and Randall, 2012; Grant et al., 2015; Hasin et al., 2018; Clay and Parker, 2018). Stress in particular can increase alcohol craving, even among people without an alcohol use disorder (AUD) (Clay and Parker, 2018). Risk for heavy drinking and AUD may be increased by stress from the social and economic circumstances brought about by the COVID-19 pandemic. Research from early in the pandemic has shown an increase in number of drinking days compared to the same time period in the previous year (McKetta et al., 2021; Capasso et al., 2021; Nordeck et al., 2021), but the impact of mental health and economic stressors on drinking, particularly high-risk drinking, have not been widely assessed. Research from previous

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epidemics suggests that negative mental health consequences of quarantine—including distress, irritability, depression, post-traumatic stress symptoms, and problematic alcohol use—may be long-lasting, enduring after the public health risk has abated (Brooks et al., 2020). Consequently, short-term stressors early in the pandemic may have long-term consequences for mental health and associated alcohol use.

While mental health problems may lead to increased risk for problematic drinking, alcohol use itself is a significant risk factor for depression and suicide (Norström and Rossow, 2016). Heavy drinking and AUD increase psychological and financial burdens on individuals who engage in these behaviors (Lewis-Laietmark et al., 2017; Greenfield et al., 2015). Therefore, increased alcohol use may exacerbate mental health problems such as depression experienced during the COVID-19 pandemic. Risk for increased alcohol use is especially salient for those who drank prior to the pandemic (North et al., 2011; Stanton et al., 2020; Hasking et al., 2011). Among individuals with a propensity for heavy drinking, an inciting potentially-traumatic event (e.g., death of a loved one, unemployment) may activate previously-formed neural pathways, intensifying cravings and increasing alcohol consumption as a coping mechanism (Stanton et al., 2020). For example, a study analyzing the prevalence of AUD among 697 survivors of 10 separate disasters found that 40% of those who developed AUD were drinkers prior to the event and directly attributed AUD development to event-related coping; in contrast, only a handful reported the onset of drinking if they were previously non-drinkers (North et al., 2011). In other words, the majority of people with post-disaster AUD represented a continuation or recurrence of preexisting problems; people with pre-existing heavy drinking or AUD may be especially vulnerable to increased drinking when exposed to highly stressful events and may need particular attention in the post-pandemic period (North et al., 2011).

The purpose of this cross-sectional study was to investigate changes in alcohol use—both in terms of increased heavy drinking and increased alcohol consumption overall—associated with stressors and other mental health problems at the beginning of the pandemic. We hypothesized individuals who reported more mental health problems (e.g., depressive symptoms) and other stressors early in the pandemic (e.g., job loss, lack of available necessities) would be more likely to report heavy drinking and increased alcohol consumption overall.

2. Methods

2.1. Participant recruitment and survey development

Data were collected as baseline for a longitudinal study of mental health and well-being during the COVID-19 pandemic (Veldhuis et al., 2021). We recruited participants via social media (e.g., Twitter, Facebook), listservs, social networks, and a research match website at Columbia University. Interested individuals who clicked on the study link were taken to an informed consent webpage that included a brief description of the survey and contact information for the study team. The survey took approximately 35 min to complete; participants were not offered compensation. After completing survey questions, participants were provided a list of possible resources (e.g., crisis hotlines, information on COVID-19 symptoms and testing) in case participants experienced distress while completing the survey. Eligible participants were 18 years or older; international participants were allowed to complete the survey, but this analysis includes only participants residing in the United States. Data collection occurred from April 5—after 43 states issued statewide stay-at-home orders (Johnson and Fritz, 2020)—to May 5, 2020.

Data were collected using the online survey tool Qualtrics. Respondents completed the questionnaire at a location of their choosing. All study procedures were reviewed and approved by the Columbia University Irving Medical Center IRB.

2.2. Measures

Alcohol consumption and changes in alcohol use behaviors. To assess average alcohol consumption, we modified a question from the National Survey on Drug Use and Health (NSDUH) (Center for Behavioral Health Statistics and Quality, 2019). Participants reported the number of drinks they consumed on average in the 7 days prior to survey administration (compared to NSDUH's 30-day reference period). A standard unit of alcohol was defined as "a can or bottle of beer; a wine cooler or a glass of wine, champagne, or sherry; a shot of liquor or a mixed drink or cocktail" (Center for Behavioral Health Statistics and Quality, 2019). To classify respondents' alcohol consumption, we used the World Health Organization (WHO) risk drinking levels, a sex-specific metric of the level of risk associated with the average daily amount of alcohol consumed (Stockwell et al., 2000). Men who reported consuming four drinks or more and women who reported three drinks or more in an average day were classified as high-risk drinkers, whereas men who reported less than four drinks or no drinks and women who reported less than three drinks or no drinks on an average day were considered moderate- or low-risk drinkers, respectively (Stockwell et al., 2000). WHO levels are a useful metric of alcohol consumption as they categorize drinkers based on intensity and frequency and identify which drinkers are at greatest risk for alcohol-related consequences (Shmulewitz et al., 2021). Multiple studies have linked higher WHO risk drinking levels with clinically-significant health conditions—including AUD, liver disease, and depressive and anxiety disorders—suggesting that WHO levels are a valid measure of alcohol consumption (Shmulewitz et al., 2021; Knox et al., 2019; Hasin et al., 2017; Witkiewitz et al., 2017; Knox et al., 2018). Participants were also asked to assess retrospective changes in alcohol consumption: "Thinking about your average weekly alcohol consumption in the past year, has your alcohol consumption over the past seven days been more than usual, the same, or less than usual?" This was recoded into a binary variable with those who reported drinking more than usual classified as "increased use behavior" and those who reported drinking the same amount or drinking less alcohol than usual as "no increase."

Depressive symptoms were measured using the Center for Epidemiologic Studies Short Depression Scale (CES-D) (Radloff, 1977; Björgvinsson et al., 2013), a short self-report scale shown to have high specificity and sensitivity in large-scale surveys (Radloff, 1977). It consists of 10 items that gauge how often over the past week the participant felt symptoms of depression (e.g., "Over the past week how often have you felt nervous, anxious, worried, or on edge?") using a 4-point Likert scale of "Rarely or none of the time (less than one day)" to "Most or all of the time (5 to 7 days)." The scale's possible range is 0 to 30, with a score of 10 or higher indicating significant depressive symptoms (Radloff, 1977; Björgvinsson et al., 2013). Internal consistency of the 10-item scale in our sample was 0.862.

Stress was measured using the Stress in Context (SIC) scale (Mendes, 2020), which consisted of 18 items (e.g., "How often do you feel socially isolated?") measured on a 4-point Likert scale of "never" to "usually." Items were summed to calculate a total score ranging from 18 to 72, with higher scores indicating higher levels of stress. Internal consistency of the 18-item scale was 0.856 in our sample.

Boredom was measured using the Multidimensional State Boredom Scale (MSBS) (Fahlman et al., 2013), which assesses feelings of boredom in the moment. It includes 17 items (e.g., "I am impatient right now;" "I am lonely;" "It seems like there's no one for me to talk to") measured on a 7-point Likert scale of "strongly disagree" to "strongly agree." Items were averaged to create an overall score ranging from 1 to 7, with higher scores signifying more boredom. The internal consistency for the 17-item scale for our sample was 0.954.

Previous mental health diagnosis. Participants were asked a binary question, "Has a doctor or other healthcare provider ever told you that you have a mental health condition?" If the participant answered "yes," the participant was asked to select all previous diagnoses; options

included depression, anxiety, PTSD, eating disorder, or substance use disorder. This specifying question was not compulsory, and participants who reported previous mental health diagnosis but declined to answer the specifying question were included in the analysis.

Difficulty obtaining necessities. To measure pandemic-related disruptions in obtaining necessities, participants were asked, "Are there things like food, medicine, or supplies you need but haven't been able to purchase?" Response options were not mutually exclusive and included, "the stores are out of what I need," "I can't afford what I need," and "it is hard to get groceries delivered." Participants who reported difficulty purchasing items because of scarcity were coded as experiencing difficulty in obtaining necessities. The other affirmative responses were not included in this analysis because they were not necessarily related to the pandemic.

Demographics included age, sex, race/ethnicity, educational attainment, sexual identity, and household makeup (e.g., living with a partner). To assess employment change, we asked if anyone in the respondent's household (including the respondent) had lost a job, had been furloughed, or had work hours reduced during the pandemic. Those who experienced one or more of these changes within their household were coded as experiencing household job loss.

2.3. Data analyses

We used logistic regression to assess possible covariates of drinking behaviors using the stats package in R 3.4.1 (R Foundation for Statistical Computing, Vienna, Austria). We first assessed the univariable relationship between odds of high-risk drinking and odds of reporting retrospective assessments of increased alcohol consumption and each covariate of interest separately. Covariates that were significant in univariable analysis (at $p < 0.05$) were included in multivariable models. We checked for multicollinearity using variance inflation factors (VIF) and model fit and parsimony with Akaike's Information Criterion (AIC). The final multivariable models presented here represent the best fitting and most parsimonious models according to the above criteria.

3. Results

Of 3358 worldwide participants, 2556 lived in the U.S. Approximately 14% ($n = 359$) of U.S. respondents did not complete the survey—meaning they started the survey but exited before all questions were answered. An additional 0.9% ($n = 22$) did not complete any questions on alcohol use. Mean age of respondents who did not complete the survey and/or any alcohol questions was 35.9 years (sd = 12.3); 86% ($n = 325$) were female, and 83% ($n = 316$) were non-Latino white. As the respondents who did not complete the survey did not appear significantly different from those who did, we considered these records to be missing at random and only analyzed complete data (Karahalios et al., 2012).

Table 1 describes the analytic sample, which includes 2175 adults who completed the survey and reported whether they consumed alcohol in the past 7 days. Mean age was 37.8 (sd = 12.8) years, 85% ($n = 1858$) were female, and 87% ($n = 1896$) were non-Latino white. Approximately one-third ($n = 729$) reported household job loss or furlough, and 60% ($n = 1308$) reported difficulty obtaining food, medicine, or other supplies. Mean CES-D score was 11.2 (sd = 6.4), indicating elevated levels of depressive symptoms in the sample. Approximately 90% were moderate- or low-risk drinkers ($n = 1949$), and over half reported a previous mental health diagnosis ($n = 1224$). Among those included in the analytic sample, 2154 adults reported whether they increased, decreased, or did not change their alcohol consumption (99.0%). Over one-third of participants who reported changes in alcohol use increased consumption ($n = 775$).

Table 2 presents results from the univariable and multivariable logistic regression models for high-risk drinking. Stress, depressive symptoms, boredom, household job loss, age, and sex were significantly associated with odds of high-risk drinking in univariable analysis and included in multivariable analysis (online supplemental Table S1). Previous mental health diagnosis was not significantly associated with risk drinking level in univariable analysis (OR = 1.31, 95% CI = (0.98, 1.76), $p = 0.068$). The final multivariable model included sex, household job loss, and depressive symptoms. In multivariable logistic regression, when controlling for depressive symptoms, household job loss was significantly associated with increased odds of high-risk drinking (OR = 1.41, 95%CI = (1.06, 1.88), $p = 0.018$), and men had lower odds of high-risk drinking than women (OR = 0.42, 95% CI = (0.21, 0.75), $p = 0.007$). Higher depressive symptom scores (OR = 1.05, 95% CI = (1.02, 1.07), $p < 0.001$) were associated with higher odds of high-risk drinking when controlling for household job loss and sex. Stress was no longer significantly associated with odds of high-risk drinking when controlling for household job loss and sex (OR = 1.01, 95% CI = (0.99, 1.03), $p = 0.347$), and boredom (OR = 0.91, 95% CI = (0.76, 1.10), $p = 0.538$) and age (OR = 0.99, 95% CI = (0.98, 1.00), $p = 0.187$) were no longer significantly associated with odds of high-risk drinking when controlling for depressive symptoms, household job loss, and sex.

Table 3 presents results from the univariable and multivariable logistic regression models for retrospective assessments of changes in alcohol use. Boredom, stress, depressive symptoms, age, living with a partner, and difficulty purchasing necessities were significantly associated with higher odds of increased alcohol use in univariable analysis and assessed in multivariable analysis (online supplemental Table S2). High-risk drinking was also significantly associated with higher odds of increased alcohol use in univariable analysis (OR = 5.96, 95%CI = (4.38, 8.21), $p < 0.001$) and included in multivariable models. The final multivariable model included boredom, living with a partner, and high-risk drinking. In multivariable logistic regression, the odds of increased alcohol consumption were almost six times higher for people engaged in high-risk drinking compared with moderate- and low-risk drinkers (OR = 5.97, 95%CI = (4.35, 8.32), $p < 0.001$) when controlling for boredom and living with a partner. Higher levels of boredom (OR = 1.26, 95% CI = (1.17, 1.36), $p < 0.001$) were positively associated with odds of increased alcohol use when controlling for living with a partner and risk drinking level. Living without a partner was associated with lower odds of increased alcohol use (OR = 0.57, 95%CI = (0.46, 0.69), $p < 0.001$), compared to living with a partner. Stress showed multicollinearity with boredom (VIF > 3), and stress was significantly correlated with boredom ($r = 0.710$, $p < 0.001$) (supplemental online Table S3). The model including stress showed poorer fit (AIC = 2555.4) compared to the model including boredom (AIC = 2552.6) when controlling for risk-drinking level and living with a partner. Age (OR = 0.997, 95%CI = (0.99, 1.01), $p = 0.534$), depressive symptoms (OR = 0.99, 95% CI = (0.97, 1.02), $p = 0.598$), and difficulty obtaining necessities (OR = 1.11, 95% CI = (0.92, 1.35), $p = 0.288$) were no longer significantly associated with change in alcohol use when included in the model with boredom, risk drinking level, and living with a partner.

4. Discussion

The COVID-19 pandemic has had drastic social and economic consequences, contributing to increased levels of anxiety, depression, and substance use in U.S. adults (Czeisler et al., 2020). The goal of this study was to examine the relationship between mental health and economic stressors early in the COVID-19 pandemic, increased heavy drinking, and increased alcohol consumption overall. In this national survey of U.S. adults, we found that household job loss and depressive symptoms were associated with higher odds of high-risk drinking, and women had higher odds of high-risk drinking compared with men. Participants reporting high-risk drinking were almost six times as likely to report retrospective increased alcohol consumption compared to low- or moderate-risk drinkers when controlling for boredom and living with a partner. These findings suggest that patterns of alcohol consumption are

Table 1
Description of sample for heavy risk drinkers compared to low- or moderate-risk drinkers and for change in alcohol consumption during COVID-19.

Variables	Total sample (n = 2175)	WHO risk drinking level (n = 2171)			Change in alcohol use (n = 2154)		
		High-risk drinkers (n = 222)	Low- or moderate- risk drinkers (n = 1949)	p[a]	Increased alcohol use (n = 775)	Did not increase alcohol use (n = 1379)	p[a]
Demographics							
Age, mean ± SD	37.8 ± 12.8	36.0 ± 11.2	37.9 ± 12.9	0.018	36.9 ± 11.6	38.1 ± 13.2	0.032
Sex, n (%)				0.021			0.399
Cisgender man	225 (10.3)	11 (5.0)	213 (10.9)		74 (9.6)	149 (10.8)	
Cisgender woman	1858 (85.4)	201 (90.5)	1654 (84.9)		672 (86.7)	1165 (84.5)	
Transgender/nonbinary	92 (4.2)	10 (4.5)	82 (4.2)		29 (3.7)	63 (4.6)	
Race/ethnicity, n (%)				0.710			0.110
Non-Latino white	1896 (87.2)	195 (87.8)	1698 (87.1)		694 (89.5)	1187 (86.1)	
Latino	117 (5.4)	10 (4.5)	107 (5.5)		39 (5.0)	77 (5.6)	
Non-Latino Black	33 (1.5)	2 (0.9)	31 (1.6)		6 (0.8)	27 (2.0)	
Non-Latino Asian	123 (5.7)	14 (6.3)	108 (5.5)		35 (4.5)	83 (6.0)	
Biracial	3 (0.1)	0 (0.0)	3 (0.2)		1 (0.1)	2 (0.1)	
Did not respond	3 (0.1)	1 (0.5)	2 (0.1)		0 (0.0)	3 (0.2)	
Sexual identity, n (%)				0.022			0.148
Heterosexual	1271 (58.4)	108 (48.6)	1162 (59.6)		431 (55.6)	823 (59.7)	
Mostly heterosexual	411 (18.9)	53 (23.9)	357 (18.3)		166 (21.4)	244 (17.7)	
Lesbian/gay	125 (5.7)	16 (7.2)	108 (5.5)		50 (6.5)	75 (5.4)	
Bisexual	242 (11.1)	33 (14.9)	208 (10.7)		88 (11.4)	153 (11.1)	
Other	118 (5.4)	12 (5.4)	106 (5.4)		37 (4.8)	79 (5.7)	
Did not respond	8 (0.4)	0 (0.0)	8 (0.4)		3 (0.4)	2 (0.1)	
Education level, n (%)				0.014			0.056
High school or less	32 (1.5)	2 (0.9)	29 (1.5)		5 (0.6)	25 (1.8)	
Technical/vocational schooling beyond high school	21 (1.0)	4 (1.8)	17 (0.9)		6 (0.8)	15 (1.1)	
Some college or currently in college (but no degree)	190 (8.7)	27 (12.2)	162 (8.3)		52 (6.7)	135 (9.8)	
Associate's degree	75 (3.4)	10 (4.5)	64 (3.3)		23 (3.0)	48 (3.5)	
Four-year college degree	597 (27.4)	64 (28.8)	533 (27.3)		215 (27.7)	378 (27.4)	
In graduate school	223 (10.3)	25 (11.3)	198 (10.2)		88 (11.4)	132 (9.6)	
Graduate or professional beyond four-year degree	700 (32.2)	68 (30.6)	631 (32.4)		263 (33.9)	434 (31.5)	
Doctorate or equivalent	337 (15.5)	22 (9.9)	315 (16.2)		123 (15.9)	212 (15.4)	
Region, n (%)				0.592			0.640
Northeast	603 (27.7)	61 (27.5)	540 (27.7)		215 (27.7)	380 (27.6)	
Midwest	478 (22.0)	53 (23.9)	424 (21.8)		159 (20.5)	314 (22.8)	
South	579 (26.6)	63 (28.4)	515 (26.4)		214 (27.6)	359 (26.0)	
West	514 (23.6)	45 (20.3)	469 (24.1)		187 (24.1)	325 (23.6)	
Did not respond	1 (0.0)	0 (0.0)	1 (0.1)		0 (0.0)	1 (0.1)	
Live with partner, n (%)				0.145			<0.001
Yes	1322 (60.8)	125 (56.3)	1195 (61.3)		513 (66.2)	799 (57.9)	
No	762 (35.0)	89 (40.1)	671 (34.4)		232 (29.9)	522 (37.9)	
Other	53 (2.4)	3 (1.4)	50 (2.6)		16 (2.1)	37 (2.7)	
Did not respond	38 (1.7)	5 (2.3)	33 (1.7)		14 (1.8)	21 (1.5)	
Economic and other stressors early in the COVID-19 pandemic							
Household job loss or reduction, n (%)				0.012			0.688
Yes	729 (33.5)	91 (40.1)	636 (32.6)		264 (34.1)	458 (33.2)	
No	1446 (66.5)	131 (59.0)	1313 (67.4)		511 (65.9)	921 (66.8)	
Difficulty purchasing food, medicine or other supplies, n (%)				0.162			0.021
Yes	1308 (60.1)	142 (64.0)	1163 (59.7)		491 (63.4)	804 (58.3)	
No	865 (39.8)	78 (35.1)	786 (40.3)		283 (36.5)	574 (41.6)	
Did not respond	2 (0.1)	2 (0.9)	0 (0.0)		1 (0.1)	1 (0.1)	
Mental health measures							
Previous mental health diagnosis, n (%)				0.069			0.686
Yes	1224 (56.3)	137 (61.7)	1087 (55.8)		439 (56.6)	772 (56.0)	
No	914 (42.0)	80 (36.0)	830 (42.6)		320 (41.3)	584 (42.3)	
Did not respond	37 (1.7)	5 (2.3)	32 (1.6)		16 (2.1)	23 (1.7)	
Previous substance use disorder diagnosis, n (%)[b]							0.855
Yes	43 (3.5)	10 (7.3)	33 (3.0)	0.011	15 (3.4)	28 (3.6)	
No	1179 (96.3)	127 (92.7)	1052 (96.8)		423 (96.4)	744 (96.5)	
Did not respond	2 (0.2)	0 (0.0)	2 (0.3)		1 (0.2)	0 (0.0)	
Number of drinks on an average day, mean ± SD	1.1 ± 2.7	4.3 ± 3.0	0.6 ± 0.9	<0.001	2.2 ± 1.5	0.8 ± 1.5	<0.001
Risk drinking level, n (%)				–			<0.001
High	222 (10.2)	–	–		163 (21.0)	59 (4.3)	
Low or moderate	1949 (89.6)	–	–		610 (78.7)	1318 (95.6)	
Did not respond	4 (0.2)	–	–		2 (0.3)	2 (0.1)	

(*continued on next page*)

Table 1 (*continued*)

Variables	Total sample ($n = 2175$)	WHO risk drinking level ($n = 2171$)			Change in alcohol use ($n = 2154$)		
		High-risk drinkers ($n = 222$)	Low- or moderate- risk drinkers ($n = 1949$)	p[a]	Increased alcohol use ($n = 775$)	Did not increase alcohol use ($n = 1379$)	p[a]
Depressive symptoms (CES-D; range: 0–30), mean ± SD	11.2 ± 6.4	13.0 ± 6.9	11.0 ± 6.3	<0.001	12.0 ± 6.1	10.7 ± 6.6	<0.001
Stress (SIC; range: 18–72), mean ± SD	40.1 ± 8.0	41.1 ± 8.5	40.0 ± 7.9	0.051	40.6 ± 7.5	39.8 ± 8.1	0.015
Boredom (MSBS; range: 1–7), mean ± SD	4.2 ± 1.3	4.5 ± 1.3	4.2 ± 1.3	0.002	4.4 ± 1.2	4.1 ± 1.3	<0.001

Note: High-risk drinking was defined as a daily average of ≥4 drinks for men and ≥ 3 drinks for women. Cisgender refers to sex assigned at birth being consistent with gender identity.

[a] Pearson chi-square test of independence for categorical variables or Welch two sample *t*-test for continues variables.

[b] Question only asked of participants who reported a previous mental health diagnosis ($n = 1224$).

Table 2
Univariable and multivariable logistic regression results for odds of high-risk drinking early in the COVID-19 pandemic, April 5–May 5, 2020 ($n = 2171$).

Variable	Odds ratio (95% CI) (univariable)	p-value	Odds ratio (95% CI) (multivariable)[a]	p-value
Age	0.988 (0.978, 0.999)	0.035		
Sex (ref: Cisgender woman)				
Cisgender man	0.424 (0.215, 0.756)	0.007	0.422 (0.213, 0.755)	0.007
Transgender/ nonbinary	1.002 (0.481, 1.874)	0.994	0.771 (0.365, 1.464)	0.458
Sexual identity (ref: Heterosexual)				
Lesbian/gay	1.598 (0.882, 2.728)	0.101		
Bisexual	1.703 (1.108, 2.557)	0.012		
Other	1.210 (0.615, 2.184)	0.552		
Mostly heterosexual	1.601 (1.122, 2.261)	0.008		
Household job loss/ reduction (ref: No)				
Yes	1.434 (1.077, 1.902)	0.013	1.413 (1.059, 1.880)	0.018
Stress	1.019 (1.001, 1.037)	0.039		
Depressive symptoms	1.048 (1.026, 1.070)	<0.001	1.046 (1.024, 1.069)	<0.001
Boredom	1.195 (1.071, 1.336)	0.002		
Previous mental health diagnosis, including substance use disorder (ref: No)				
Yes	1.310 (0.983, 1.757)	0.068		
AIC	–		1409.6	

Note: High-risk drinking was defined as a daily average of ≥4 drinks for men and ≥ 3 drinks for women. Cisgender refers to sex assigned at birth being consistent with gender identity.

[a] Adjusted for other variables in the column.

Table 3
Univariable and multivariable logistic regression results for odds of retrospectively-reported increased alcohol consumption early in the COVID-19 pandemic, April 5–May 5, 2020 ($n = 2154$).

Variable	Odds ratio (95% CI) (univariable)	p-value	Odds ratio (95% CI) (multivariable)[a]	p-value
Age	0.993 (0.986, 0.999)	0.039		
Live with partner (ref: Yes)				
No	0.688 (0.568, 0.831)	<0.001	0.566 (0.460, 0.694)	<0.001
Other	0.672 (0.360, 1.199)	0.191	0.655 (0.343, 1.197)	0.182
Risk level (ref: Low/moderate)				
High	5.960 (4.384, 8.206)	<0.001	5.972 (4.345, 8.316)	<0.001
Boredom	1.236 (1.153, 1.326)	<0.001	1.261 (1.170, 1.360)	<0.001
Stress	1.014 (1.002, 1.025)	0.0179		
Depressive symptoms	1.033 (1.019, 1.047)	<0.001		
Difficulty purchasing food, medicine or other supplies (ref: No)				
Yes	1.239 (1.034, 1.486)	0.021		
Previous mental health diagnosis, including substance use disorder (ref: No)				
Yes	1.041 (0.870, 1.257)	0.661		
AIC	–		2552.6	

Note: High-risk drinking was defined as a daily average of ≥4 drinks for men and ≥ 3 drinks for women.

[a] Adjusted for other variables in the column.

associated with individual mental health and economic stressors, and that severity of alcohol consumption was significantly associated with increased alcohol use early in the pandemic. Furthermore, previous mental health diagnosis was not significantly associated with high-risk drinking, suggesting that mental health stressors early in the pandemic may influence heavy drinking during the pandemic. Further inquiry is necessary to identify the impact of mental health stressors early in the pandemic on heavy drinking independent of pre-existing mental health conditions and the long-term consequences of heavy drinking once the pandemic has abated.

Household job loss was associated with a 41% increase in the odds of high-risk drinking when controlling for sex and depressive symptoms. Our findings are consistent with previous studies conducted prior to the pandemic showing that economic strain is associated with increased heavy drinking (Shaw et al., 2011) and with national surveys showing increased substance use during the COVID-19 pandemic (Czeisler et al., 2020). A survey of Canadian adults also found that COVID-19-related income loss was associated with increased alcohol use (Wardell et al., 2020). Furthermore, difficulty obtaining food, medicine, and other supplies was positively associated with increased alcohol consumption

in univariable analysis, though not in multivariable analysis, suggesting that stressors during the early period of the pandemic may have influenced alcohol consumption. More research is needed to better understand how these short- and long-term stressors impact long-term alcohol use.

The odds of high-risk drinking were significantly elevated for women when controlling for stress, depressive symptoms, and household job loss. This finding is supported by a national survey of U.S. adults that also found a significant increase in heavy drinking days for women in May and June of 2020 compared with the same time period during the previous year (Pollard et al., 2020). This may reflect the disproportionate strain women face during the pandemic as they balance multiple high-demand roles including primary caregiving while maintaining full-time employment (McGinty et al., 2020; Holingue et al., 2020; Stanton et al., 2020). Sex differences in alcohol use also could be because women rely on social-emotional coping such as peer support during stressful events, which would be disrupted during social isolation measures and stay-at-home orders (Matud, 2004). The pandemic curtailed these resources, possibly placing women at higher risk of depressive symptoms and increased alcohol use (Taylor and Stanton, 2007). Increased alcohol use among women during the COVID-19 pandemic has also been associated with a 39% increase in alcohol-related problems (Pollard et al., 2020). This is consistent with nationally-representative studies showing women may be at higher risk for drinking problems, including heavy drinking and AUD (Grant et al., 2017). Future studies should investigate the differential impact of mental health stressors on high-risk drinking among women to inform interventions to support women during and after the pandemic.

High-risk drinking was associated with a sextupled odds of retrospectively-reported increased alcohol use compared with those reporting moderate or low-risk drinking, after adjusting for boredom and living with a partner. These findings are consistent with other studies conducted during the pandemic, which showed increased number of drinking days in March and April of 2020 (McKetta et al., 2021; Capasso et al., 2021; Nordeck et al., 2021). This is concerning because high-risk drinking is associated with increased risk of adverse consequences including alcohol-related injuries, violence, and alcohol poisoning, and increased alcohol use could contribute to increased risk for alcohol-related problems (Centers for Disease Control and Prevention, 2020). In addition to negative physical health consequences, increased alcohol use among those already engaged in high-risk drinking may exacerbate mental health problems such as anxiety or depression (Pollard et al., 2020). As previous studies of disease outbreaks have shown problematic alcohol use as a long-term consequence of physical distancing (Brooks et al., 2020; North et al., 2011), addressing mental health stressors is essential for reducing alcohol consumption after the pandemic.

Study limitations are noted. This study uses a cross-sectional convenience sample recruited through social media, limiting generalizability; causal inferences on the pandemic's impact on alcohol use were not possible. The majority of our participants were non-Latino white, limiting our ability to discuss racial/ethnic differences in alcohol use-related stressors early in the pandemic. Difficulty obtaining food, medicine, and other necessities were collapsed together as a single measure, limiting our ability to disaggregate specific associations with alcohol use. This study did not purposively recruit people who use alcohol; findings may not be generalizable to people with problematic alcohol use or AUD. Of the total U.S. sample, 15% declined to report the number of drinks consumed in the past 7 days, and 16% did not report changes in alcohol consumption. It is possible these participants were engaged in problematic drinking, or underestimated problematic alcohol behaviors, which could have introduced selection bias in our study. Although we used the NSDUH's definition of a standard unit of alcohol, we did not include graphical representations of standard units across types of beverages, and reports of drinking changes were retrospective; there is possible bias in reported units of alcohol consumed and changes in drinking as a result. However, because little empirical research exists on changes in drinking behaviors in the U.S. related to mental health and economic problems during the early days of the pandemic, we believe this study provides valuable insights into drinking behaviors in general and urge more in-depth, targeted research into changes in alcohol use behaviors during the pandemic and beyond.

5. Conclusion

Household job loss and higher levels of reported depressive symptoms early in the COVID-19 pandemic were associated with higher odds of high-risk drinking. Our findings regarding women's alcohol consumption also suggest that women had higher odds of high-risk drinking, which could lead to more alcohol-related problems in the long term. High-risk drinkers who increased alcohol consumption at the beginning of the pandemic further elevated the risks associated with alcohol and may need tailored interventions to help decrease their alcohol consumption after the pandemic has abated. Previous mental health diagnosis was not significantly associated with high-risk drinking during the pandemic, suggesting that mental health stressors early in the pandemic influenced heavy drinking independent of pre-existing mental health conditions. These findings suggest a need for targeted interventions to address the complex mental health and economic stressors that were associated with increased alcohol consumption and high-risk drinking during the COVID-19 pandemic and the ramifications of increased drinking in the post-pandemic era.

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Ethical approval

This research was approved by the Institutional Review Board at the Columbia University Medical Center (protocol #AAAS9704). All procedures performed were in accordance with the ethical standards of the Columbia University Medical Center's Institutional Review Board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Declaration of competing interest

All authors have no possible conflicts of interest to disclose.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2021.106854.

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