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Article

Alcohol Consumption and Mental Health during the COVID-19 Pandemic

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Abstract

Aims: To examine the association between alcohol consumption and mental health during the COVID-19 pandemic.

Methods: An anonymous online survey was distributed among US adults during May–August 2020 through social networks and ResearchMatch. We collected information on demographic, lifestyles and mental health symptoms including anxiety, depression, stress and post-traumatic stress disorder. Logistic regression models were used to examine the cross-sectional association between alcohol consumption and mental health symptoms. We also examined effect modification by race, age, gender, social support, financial insecurity and quarantine status.

Results: The analytical sample consists of 3623 adults. Stable drinking habits and regular drinking behaviors were found to co-exist with better mental health status. Participants who increased their alcohol use had higher odds of developing mental health disorders than those who maintained their pre-pandemic drinking habits. Additionally, participants who engaged in binge drinking during the pandemic had higher odds of depression and stress than those who did not. The associations regarding increased drinking and binge drinking in relation to adverse mental health outcomes were stronger among females, racial minorities, and individuals with financial concerns, poor social support and restricted quarantine status than their counterparts.

Conclusions: During the early stage of the COVID-19 pandemic, increased alcohol use and binge drinking are cross-sectionally associated with higher odds of mental health disorders, which highlighted the need for targeted intervention to address the mental health needs of individuals who have engaged in these behaviors, especially among females, minorities, those with insecurities or with restricted quarantine status.

BACKGROUND

Emerging evidence suggests that alcohol use increased during the COVID-19 pandemic (WHO, 2020). US adults had 0.74 more days per month consuming alcohol from May to June 2020 compared with the same time in 2019 (Pollard *et al*., 2020). US alcohol sales also increased by 34% in the early stage of the pandemic compared with the same period in the year before (Lee *et al*. 2021).

Given the health risks and economic challenges, the pandemic increases the prevalence of early-onset mental health problems and exacerbates preexisting mental health conditions. The pandemic witnesses a global estimated prevalence of 27% for anxiety, 28% for depression, 37% for stress and 24% for post-traumatic stress disorder (PTSD) symptoms (Nochaiwong *et al*., 2021). These rates are approximately two times higher than the 2019 US pre-pandemic rates of 15.6% for anxiety (Terlizzi and Villarroel, 2020) and 18.5% for depression (Villarroel and Terlizzi, 2020). Additionally, a study observed a 10-fold increase in PTSD, which had an annual estimated prevalence of 3.6% among US adults before the pandemic (Kessler *et al*., 2005).

Alcohol misuse has been hypothesised to be associated with several different psychiatric disorders such as stressed, loneliness and hopelessness (Thompson *et al*., 2021). The COVID-19 pandemic has also had profound economic effects and has exaggerated existing inequities. Previous research has highlighted the impact of social determinants in the context of alcohol consumption, alcohol-related harm and mental health outcomes (Probst *et al*., 2020), and these inequities may intensify the social susceptibility of certain populations to mental health problems during the pandemic.

Several studies have investigated the association between alcohol use and mental health during the pandemic, but

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results have been inconsistent (Lechner *et al*., 2020; Smith *et al*., 2020; Greenberg *et al*., 2021); besides, few studies have examined drinking patterns comprehensively. Our study aims to investigate the association of four dimensions of drinking patterns with mental health disorders during the pandemic, while also considering potential effect modifiers including race/ethnicity, age, gender, financial concerns, social support and stay-at-home status, as social determinants can affect an individual's response when coping with both financial and psychological challenges. We hypothesised that changes in alcohol use habits and the adoption of varying drinking patterns, as the COVID-19 pandemic present different mental health outcomes and that these associations can be influenced by social determinants.

METHOD

We conducted a cross-sectional study utilising an online survey over the REDCap platform (Nashville, TN) distributed via various social media networks (e.g. Facebook, Twitter) and ResearchMatch between May 13 and August 25, 2020, among adults aged ≥18 years residing in the USA. We received responses from the 3952 participants and collected their socio-demographic information such as age, gender, race, employment status, social support, financial insecurities, COVID-19 infection and quarantine status, behavioral changes and current patterns and mental health (Zhu *et al*., 2021). This study was reviewed and approved by the Institutional Review Board of the University at Buffalo.

Exposure assessment

Self-reported measures of alcohol consumption were obtained from four questions: (i) drinking frequency during the pandemic, classified as 'never drink', 'once a month or less', '2–4 times a month', '2–3 times a week' and '4 or more times a week'; (ii) drinking amount per occasion among alcohol users, classified as 1–2 drink, 3–4 drinks, 5–6 drinks, 7–9 drinks and 10 drinks or more; (iii) change in alcohol consumption since the COVID-19 pandemic (options included 'increased,' 'decreased' and 'no change'), and 'non-drinkers' were separated from 'no change' in (i); and (iv) binge drinking frequency (defined as drinking ≥6 drinks at one occasion), classified as 'never', 'less than monthly', 'monthly', 'weekly' and 'daily or almost daily'. Monthly alcohol consumption was determined by calculating the product of drinking frequency and drinking amount per occasion, and was classified as 'never drink', 'less than 10 drinks per month' and '10 drinks or more per month'.

Mental health assessment

Self-reported symptoms of anxiety, depression, stress and PTSD by participants were obtained. Measures of anxiety symptoms were assessed through the Generalized Anxiety Disorder Scale-7 items (GAD-7; Spitzer *et al*., 2006). GAD-7 includes seven behavioral items that detect the frequency of anxiety symptoms in the past two weeks. Respondents were given four options scored as 0 (not at all), 1 (several days), 2 (over half the days) and 3 (nearly every day), resulting in a possible summed score from 0 to 21. Measures of depression among participants were classified using the Patient Health Questionnaire-9 items (PHQ-9; Kroenke *et al*., 2001). PHQ-9 consists of nine behavioral indicators, scoring the frequency of depression symptoms (identical scores as GAD-7) over the past 2 weeks between scores of 0 and 27. On the GAD-7 and PHQ-9 scales, scores of ≥10 were defined as moderate to severe anxiety and depression, respectively. Stress levels were measured by the Perceived Stress Scale-4 items (PSS-4; Cohen *et al*., 1983). PSS-4 contains 4 elements scored as 0 (not at all), 1 (almost never), 2 (sometimes), 3 (fairly often) and 4 (very often), with a summed score ranging from 0 to 16, and a total score ≥ 6 was classified as medium or high for stress symptoms. PTSD was measured using the primary care PTSD screen (PC-PTSD). PC-PTSD consists of four items in a dichotomous response format (yes/no) inquiring whether respondents have experienced symptoms of PTSD in the past month. A total score ≥ 3 on the PC-PTSD scale (meaning respondents answered 'yes' for three or more items) was classified as positive for PTSD symptoms. We used the aforementioned cut-off points dividing the mental health status into dichotomised variables as none/mild and moderate/severe, and some studies have validated their accuracy, including anxiety (Mughal *et al*., 2020), depression (Volker *et al*., 2016), stress (Cohen *et al*., 1983) and PTSD (Prins *et al*., 2003).

Data analyses

All descriptive and statistical analyses were performed with SAS version 9.4 (SAS Institute Inc., Cary, NC). Participants with incomplete data on alcohol drinking or mental health symptoms were excluded from the final analytical sample. We described the distribution of demographic and socioeconomic characteristics of participants according to the presence of mental health symptoms and alcohol drinking patterns. Chi-square tests were used to examine the group differences in distribution, and the differences were deemed statistically significant at P-value < 0.05. Multivariable logistic regression models were used to investigate the association of alcohol drinking behaviors including changes in alcohol consumption, changes in alcohol consumption among drinkers, frequency of alcohol drinking, monthly drinking amount and frequency of binge drinking with mental health symptoms. Age, gender, race/ethnicity, education level, family income, COVID-19 infection history, smoking status, marital status, employment and quarantine status were identified as potential confounders based on previous literature that suggested the associations with both alcohol drinking and mental health status (Lo and Cheng, 2018; Subbaraman *et al*., 2020). Furthermore, to identify potential effect modifiers in the association between alcohol consumption and adverse mental health symptoms, we stratified the associations regarding factors associated with adverse mental health symptoms by race, age, gender social support, financial insecurity and quarantine status; in addition, the interaction terms between the aforementioned factors and the potential effect modifiers were included in corresponding logistic models, and the interaction was deemed statistically significant at P-value < 0.10.

RESULT

After excluding observations with incomplete data on alcohol consumption and mental health symptoms, 3623 individuals were included in the final analytical sample. The prevalence of anxiety (22.7%), depression (26.7%), stress (51.0%) and PTSD (21.8%) symptoms was identified from May to August 2020 when the 'stay-at-home' policy was issued for at least

2 months. Participants' characteristics are summarised in Table 1. Features including female, employed, worried about money, insurance, or food and grocery items, with COVID-19 infection history, currently smoking and restricted quarantine status due to recommendation or exposure were observed to be associated with mental health disorders. Meanwhile, characteristics including being elderly, non-Hispanic white, higher education level, higher household income (>$74,999), married and living together with the significant other were observed to be associated with less likelihood of mental health disorder.

The supplementary table presents the distribution of characteristics by drinking patterns since the pandemic. Compared with drinking habits before the pandemic, 8.0% of participants reported a decrease in alcohol consumption, 41.1% did not change their drinking habits, 22.8% increased their alcohol consumption and 28.2% remained non-drinkers. Characteristics including being female, middle-aged (31–60 years old), Hispanic/Latino, more educated, employed and with more household income (> $150,000 annually) were observed to be associated with increased alcohol consumption. During the pandemic, 35.1% of participants drank one or more times per week and 17.0% of participants had ever binge drunk (≥ 6 drinks on one occasion) weekly or more frequently. Individuals without any financial concerns tended to drink more often, compared with people who were worried about money, food & grocery items or insurance (all $P < 0.01$). However, people who had worries about money or insurance were more likely to binge drink than those who did not (both $P < 0.01$).

Multivariable logistic regression models were conducted to investigate the association between alcohol consumption and mental health symptoms (Table 2). Compared with abstainers, drinkers who did not change their drinking habits during the pandemic had significantly lower odds of having anxiety (odds ratio [OR] = 0.77, 95% confidence interval [CI]: 0.63–0.95), depression (OR = 0.72, 95% CI: 0.59–0.88), stress (OR = 0.78, 95% CI: 0.66–0.93) and PTSD (OR = 0.73, 95% CI: 0.59–0.90). Meanwhile, those who increased their consumption level had higher odds of PTSD (OR = 1.28, 95% CI: 1.02–1.61). After excluding abstainers, compared with participants who did not change their drinking habits since the COVID-19 pandemic, participants who increased their alcohol consumption had higher odds of having anxiety (OR = 1.58, 95% CI: 1.27–1.96), depression (OR = 1.48, 95% CI: 1.20–1.82), stress (OR = 1.46, 95% CI: 1.22–1.75) and PTSD (OR = 1.79, 95% CI: 1.49–2.22). Compared with people who never drank during the pandemic, individuals who drank had lower odds of all mental health symptoms, and the odds decreased with increased frequency and monthly drinking dose. Specifically, individuals who drank weekly or more often and individuals who drank 10 drinks or more per month had significantly lower odds of depression, with ORs of 0.74 (95%: 0.61–0.91) and 0.75 (95%: 0.62–0.92), respectively. On the other hand, for binge drinkers, there was not the same decrease in the odds of symptoms. Compared with the individuals who did not ever binge drink during the COVID-19 pandemic, individuals who did had higher odds of reporting depression (OR = 1.3, 95%CI: 1.06–1.59) and stress (OR = 1.28, 95% CI: 1.06–1.54).

As we observed positive associations of increased alcohol use and binge drinking with mental health disorder, we stratified their associations by social determinants in order to identify factors modifying these associations, as shown in Tables 3 and 4, and visualised in Fig. 1.

Table 3 presents the stratified associations between increased alcohol consumption and mental health symptoms by gender, age, race, social support, financial concerns and the stay-at-home status during the pandemic, compared with drinkers who did not change their alcohol consumption. Significant interaction terms (P for interaction<0.10) were observed after stratifying the associations by race and worries about money. Specifically, racial minorities had a higher OR of increased alcohol consumption with stress symptoms (OR = 3.01, 95% CI: 1.33, 6.82), compared with non-Hispanic Whites (OR = 1.48, 95% CI: 1.21, 1.80); participants who were worried about money had a higher OR (OR = 1.59, 95% CI: 1.20, 2.12), compared with those without worries about money (OR: 1.26, 95% CI: 0.98, 1.62). Further, the estimated ORs of staying at home due to exposure were higher than other restriction status, although the associations were not statistically significant due to small sample sizes (N for no change vs. N for increased = 85 vs. 32).

Same set of stratifications were applied to the association between binge drinking and mental health symptoms, as shown in Table 4. Significant interaction terms (P for interaction<0.10) were observed after stratifying the associations by gender, worries about money, insurance or food & grocery items. For example, females had higher ORs of 1.38 (95% CI: 1.10, 1.73) and 1.29 (95% CI: 1.04, 1.60) for depression and PTSD, respectively, than males with corresponding OR = 0.91 (95% CI: 0.58, 1.42) and OR = 1.25 (95% CI: 0.98, 1.48); participants who were worried about food and grocery items had higher OR = 1.39 (95% CI: 1.03, 1.90) for anxiety than those who were not (OR = 0.89, 95% CI: 0.66, 1.19). Moreover, the significant associations regarding binge drinking in relation to depression and PTSD disorders only exist among those who reported poor social support; participants who went to work/school sometimes had negative although not significant associations between binge drinking and mental health.

DISCUSSION

To the best of our knowledge, among the limited studies examining the association between alcohol consumption and mental health during the COVID-19 pandemic, this study has the most comprehensive assessment of drinking patterns and is the first study examining their association with four clinically prevalent mental health disorders among the US population. Further, stratified analyses by social determinants identified the most vulnerable groups for mental health symptoms, including females, racial minorities and individuals with poor social support, financial concerns and restricted stay-at-home status.

In this study, we found that compared with abstainers, individuals who maintained their drinking habits during the COVID-19 pandemic had better mental health status, while increased alcohol consumption was associated with poorer mental health. In another study conducted during the pandemic, the positive association of adverse mental health outcomes with increased alcohol consumption was also observed in a UK population sample (Jacob *et al*., 2021). As for the consumption frequency, additionally, we found that weekly drinkers or drinkers who monthly consumed 10

Table 1. Descriptive characteristics by mental health symptoms

	Anxiety			Depression			Stress			PTSD		
	No ($N = 3053$)	Yes ($N = 899$)	*P*	No ($N = 2898$)	Yes ($N = 1054$)	*P*	No ($N = 1935$)	Yes ($N = 2017$)	*P*	No ($N = 3090$)	Yes ($N = 862$)	*P*
Age												
<30 (459)	283 (9.27)	176 (19.58)		261 (9.01)	198 (18.79)		144 (7.44)	315 (15.62)		293 (9.48)	166 (19.26)	
30–59 (1905)	1358 (44.48)	547 (60.85)		1297 (44.76)	608 (57.69)		828 (42.79)	1077 (53.40)		1398 (45.24)	507 (58.82)	
≥60 (1588)	1412 (46.25)	176 (19.58)	<0.01	1340 (46.24)	248 (23.53)	<0.01	963 (49.77)	625 (30.99)	<0.01	1399 (45.28)	189 (21.93)	<0.01
Gender												
Male (835)	690 (22.60)	145 (16.13)		658 (22.71)	177 (16.79)		457 (23.62)	378 (18.74)		709 (22.94)	126 (14.62)	
Female (3117)	2363 (77.40)	754 (83.87)	<0.01	2240 (77.29)	877 (83.21)	<0.01	1478 (76.38)	1639 (81.26)	0.00	2381 (77.06)	736 (85.38)	<0.01
Race												
Non-Hispanic White (3240)	2526 (82.74)	714 (79.42)		2405 (82.99)	835 (79.22)		1623 (83.88)	1617 (80.17)		2540 (82.2)	700 (81.21)	
Non-Hispanic Black (227)	185 (6.06)	42 (4.67)		168 (5.8)	59 (5.60)		123 (6.36)	104 (5.16)		180 (5.83)	47 (5.45)	
Hispanic/Latino (101)	73 (2.39)	28 (3.11)		65 (2.24)	36 (3.42)		36 (1.86)	65 (3.22)		69 (2.23)	32 (3.71)	
Asian/Pacific Islander (106)	79 (2.59)	27 (3.00)		73 (2.52)	33 (3.13)		39 (2.02)	67 (3.32)		82 (2.65)	24 (2.78)	
Other/multiracial (243)	168 (5.50)	75 (8.34)		163 (5.62)	80 (7.59)		105 (5.43)	138 (6.84)		189 (6.12)	54 (6.26)	
Missing (35)	22 (0.72)	13 (1.45)	0.01	24 (0.83)	11 (1.04)	0.02	9 (0.47)	26 (1.29)	0.00	30 (0.97)	5 (0.58)	0.19
Education												
Middle school graduate or lower (9)	6 (0.20)	3 (0.33)		5 (0.17)	4 (0.38)		3 (0.16)	6 (0.30)		5 (0.16)	4 (0.46)	
High school degree or equivalent (135)	79 (2.59)	56 (6.23)		76 (2.62)	59 (5.60)		51 (2.64)	84 (4.16)		93 (3.01)	42 (4.87)	
Some college/vocation al school (650)	456 (14.94)	194 (21.58)		412 (14.22)	238 (22.58)		254 (13.13)	396 (19.63)		496 (16.05)	154 (17.87)	
College graduate (1434)	1117 (36.59)	317 (35.26)		1067 (36.82)	367 (34.82)		702 (36.28)	732 (36.29)		1109 (35.89)	325 (37.70)	
Graduate or higher (1724)	1395 (45.69)	329 (36.60)	<0.01	1338 (46.17)	386 (36.62)	<0.01	925 (47.80)	799 (39.61)	<0.01	1387 (44.89)	337 (39.10)	<0.01
Marital status												
Never married (932)	640 (20.96)	292 (32.48)		566 (19.53)	366 (34.72)		327 (16.9)	605 (30.00)		656 (21.23)	276 (32.02)	
Not married but living together (309)	210 (6.88)	99 (11.01)		208 (7.18)	101 (9.58)		124 (6.41)	185 (9.17)		211 (6.83)	98 (11.37)	
Married and living together (1857)	1511 (49.49)	346 (38.49)		1501 (51.79)	356 (33.78)		1034 (53.44)	823 (40.80)		1526 (49.39)	331 (38.40)	
Married but separated (66)	45 (1.47)	21 (2.34)		38 (1.31)	28 (2.66)		19 (0.98)	47 (2.33)		53 (1.72)	13 (1.51)	
Divorced (590)	476 (15.59)	114 (12.68)		428 (14.77)	162 (15.37)		310 (16.02)	280 (13.88)		477 (15.44)	113 (13.11)	
Widowed (192)	167 (5.47)	25 (2.78)		153 (5.28)	39 (3.70)		117 (6.05)	75 (3.72)		163 (5.28)	29 (3.36)	
Missing (6)	4 (0.13)	2 (0.22)	<0.01	4 (0.14)	2 (0.19)	<0.01	4 (0.21)	2 (0.10)	<0.01	4 (0.13)	2 (0.23)	<0.01
Income												
< $20k (280)	170 (5.57)	110 (12.24)		133 (4.59)	147 (13.95)		80 (4.13)	200 (9.92)		185 (5.99)	95 (11.02)	
$20k to $49.9k (763)	552 (18.08)	211 (23.47)		503 (17.36)	260 (24.67)		321 (16.59)	442 (21.91)		581 (18.80)	182 (21.11)	
$50k to $74.9k (817)	627 (20.54)	190 (21.13)		598 (20.63)	219 (20.78)		402 (20.78)	415 (20.58)		647 (20.94)	170 (19.72)	
$75k to $149.9k (1320)	1054 (34.52)	266 (29.59)		1014 (34.99)	306 (29.03)		672 (34.73)	648 (32.13)		1040 (33.66)	280 (32.48)	
$150k to $224.9k (473)	392 (12.84)	81 (9.01)		397 (13.70)	76 (7.21)		270 (13.95)	203 (10.06)		393 (12.72)	80 (9.28)	
$225k and over (219)	187 (6.13)	32 (3.56)		185 (6.38)	34 (3.23)		135 (6.98)	84 (4.16)		175 (5.66)	44 (5.10)	
Missing (80)	71 (2.33)	9 (1.00)	<0.01	68 (2.35)	12 (1.14)	<0.01	55 (2.84)	25 (1.24)	<0.01	69 (2.23)	11 (1.28)	<0.01
Employ												
No (1714)	1339 (43.86)	375 (41.71)		1243 (42.89)	471 (44.69)		862 (44.55)	852 (42.24)		1355 (43.85)	359 (41.65)	
Yes (2227)	1703 (55.78)	524 (58.29)		1647 (56.83)	580 (55.03)		1068 (55.19)	1159 (57.46)		1725 (55.83)	502 (58.24)	
Missing (11)	11 (0.36)	0 (0)	0.22	8 (0.28)	3 (0.28)	0.31	5 (0.26)	6 (0.30)	0.15	10 (0.32)	1 (0.12)	0.23
Social support												
Poor (1317)	953 (31.22)	364 (40.49)		862 (29.74)	455 (43.17)		559 (28.89)	758 (37.58)		1015 (32.85)	302 (35.03)	
Moderate (2349)	1871 (61.28)	478 (53.17)		1811 (62.49)	538 (51.04)		1226 (63.36)	1123 (55.68)		1863 (60.29)	486 (56.38)	
Strong (271)	216 (7.08)	55 (6.12)		212 (7.32)	59 (5.60)		144 (7.44)	127 (6.30)		200 (6.47)	71 (8.24)	
Missing (15)	13 (0.43)	2 (0.22)	<0.01	13 (0.45)	2 (0.19)	<0.01	6 (0.31)	9 (0.45)	<0.01	12 (0.39)	3 (0.35)	0.06
Worry about money												
Extremely worried (397)	157 (5.14)	240 (26.70)		148 (5.11)	249 (23.62)		50 (2.58)	347 (17.20)		206 (6.67)	191 (22.16)	
A little bit worried (1431)	1021 (33.44)	410 (45.61)		937 (32.33)	494 (46.87)		522 (26.98)	909 (45.07)		1047 (33.88)	384 (44.55)	

(Continued)

Table 1. Continued

	Anxiety			Depression			Stress			PTSD		
	No ($N = 3053$)	Yes ($N = 899$)	*P*	No ($N = 2898$)	Yes ($N = 1054$)	*P*	No ($N = 1935$)	Yes ($N = 2017$)	*P*	No ($N = 3090$)	Yes ($N = 862$)	*P*
Not worried at all (2112)	1864 (61.05)	248 (27.59)		1803 (62.22)	309 (29.32)		1356 (70.08)	756 (37.48)		1828 (59.16)	284 (32.95)	
Missing (12)	11 (0.36)	1 (0.11)	<0.01	10 (0.35)	2 (0.19)	<0.01	7 (0.36)	5 (0.25)	<0.01	9 (0.29)	3 (0.35)	<0.01
Worry about insurance												
Extremely worried (299)	134 (4.39)	165 (18.35)		129 (4.45)	170 (16.13)		41 (2.12)	258 (12.79)		152 (4.92)	147 (17.05)	
A little bit worried (940)	647 (21.19)	293 (32.59)		596 (20.57)	344 (32.64)		341 (17.62)	599 (29.70)		665 (21.52)	275 (31.90)	
Not worried at all (2706)	2265 (74.19)	441 (49.05)		2167 (74.78)	539 (51.14)		1548 (80.00)	1158 (57.41)		2268 (73.40)	438 (50.81)	
Missing (7)	7 (0.23)	0 (0)	<0.01	6 (0.21)	1 (0.09)	<0.01	5 (0.26)	2 (0.10)	<0.01	5 (0.16)	2 (0.23)	<0.01
Worry about food and grocery items												
Extremely worried (215)	76 (2.49)	139 (15.46)		69 (2.38)	146 (13.85)		17 (0.88)	198 (9.82)		101 (3.27)	114 (13.23)	
A little bit worried (1113)	745 (24.40)	368 (40.93)		691 (23.84)	422 (40.04)		382 (19.74)	731 (36.24)		765 (24.76)	348 (40.37)	
Not worried at all (2621)	2229 (73.01)	392 (43.60)		2136 (73.71)	485 (46.02)		1534 (79.28)	1087 (53.89)		2222 (71.91)	399 (46.29)	
Missing (3)	3 (0.10)	0 (0)	<0.01	2 (0.07)	1 (0.09)	<0.01	2 (0.10)	1 (0.05)	<0.01	2 (0.06)	1 (0.12)	<0.01
COVID-19 infection history												
Yes (82)	50 (1.64)	32 (3.56)		50 (1.73)	32 (3.04)		31 (1.60)	51 (2.53)		53 (1.72)	29 (3.36)	
No (3870)	3003 (98.36)	867 (96.44)	0.00	2848 (98.27)	1022 (96.96)	0.01	1904 (98.4)	1966 (97.47)	0.04	3037 (98.28)	833 (96.64)	<0.01
Current smoker												
No (3620)	2864 (93.81)	756 (84.09)		2711 (93.55)	909 (86.24)		1839 (95.04)	1781 (88.3)		2863 (92.65)	757 (87.82)	
Yes (315)	174 (5.70)	141 (15.68)		172 (5.94)	143 (13.57)		85 (4.39)	230 (11.40)		211 (6.83)	104 (12.06)	
Missing (17)	15 (0.49)	2 (0.22)	<0.01	15 (0.52)	2 (0.19)	<0.01	11 (0.57)	6 (0.30)	<0.01	16 (0.52)	1 (0.12)	<0.01
Stay-at-home (SAH) status												
No restriction or went to work/school regularly (583)	465 (15.23)	118 (13.13)		446 (15.39)	137 (13.00)		307 (15.87)	276 (13.68)		479 (15.50)	104 (12.06)	
SAH most of the time but went to work/school sometimes (628)	504 (16.51)	124 (13.79)		486 (16.77)	142 (13.47)		317 (16.38)	311 (15.42)		500 (16.18)	128 (14.85)	
SAH for work/school because of the recommendations (2438)	1867 (61.15)	571 (63.52)		1767 (60.97)	671 (63.66)		1183 (61.14)	1255 (62.22)		1882 (60.91)	556 (64.5)	
SAH due to exposure (217)	151 (4.95)	66 (7.34)		136 (4.69)	81 (7.69)		87 (4.50)	130 (6.45)		158 (5.11)	59 (6.84)	
Missing (86)	66 (2.16)	20 (2.22)	0.00	63 (2.17)	23 (2.18)	<0.01	41 (2.12)	45 (2.23)	0.01	71 (2.30)	15 (1.74)	0.01

Table 2. Association[a] between alcohol consumption and mental health symptoms

	Anxiety		Depression		Stress		PTSD	
	No ($N = 3053$) Crude	Yes ($N = 899$) Adjusted[a]	No ($N = 2898$) Crude	Yes ($N = 1054$) Adjusted[a]	No ($N = 1935$) Crude	Yes ($N = 2017$) Adjusted[a]	No ($N = 3090$) Crude	Yes ($N = 862$) Adjusted[a]
Change of alcohol consumption after COVID-19 pandemic								
Non-drinker ($N = 1019$)	Reference							
No change ($N = 1478$)	**0.70 (0.57, 0.85)**	**0.77 (0.63, 0.95)**	**0.62 (0.52, 0.74)**	**0.72 (0.59, 0.88)**	**0.72 (0.61, 0.84)**	**0.78 (0.66, 0.93)**	**0.67 (0.54, 0.81)**	**0.72 (0.58, 0.89)**
Increased ($N = 837$)	1.26 (1.02, 1.55)	1.22 (0.97, 1.53)	1.01 (0.83, 1.23)	1.07 (0.85, 1.33)	1.15 (0.96, 1.39)	1.15 (0.94, 1.41)	**1.38 (1.12, 1.7)**	**1.28 (1.02, 1.61)**
Decreased ($N = 289$)	1.19 (0.88, 1.6)	0.96 (0.69, 1.32)	1.23 (0.93, 1.63)	1.05 (0.77, 1.42)	**1.35 (1.04, 1.77)**	1.14 (0.86, 1.52)	1.15 (0.85, 1.55)	0.91 (0.66, 1.26)
Change of alcohol consumption among drinkers after COVID-19 pandemic								
No change ($N = 1478$)	Reference							
Increased ($N = 837$)	**1.81 (1.48, 2.21)**	**1.58 (1.27, 1.96)**	**1.63 (1.34, 1.98)**	**1.48 (1.20, 1.83)**	**1.61 (1.36, 1.91)**	**1.46 (1.22, 1.75)**	**2.08 (1.70, 2.54)**	**1.79 (1.45, 2.22)**
Decreased ($N = 289$)	1.36 (0.97, 1.90)	0.99 (0.69, 1.42)	**1.79 (1.32, 2.42)**	1.34 (0.96, 1.87)	**1.6 (1.21, 2.12)**	1.26 (0.93, 1.71)	**1.58 (1.13, 2.2)**	1.21 (0.85, 1.73)
Drinking frequency during COVID-19 pandemic								
Never drink ($N = 1155$)	Reference							
Less than weekly ($N = 1264$)	0.95 (0.79, 1.15)	0.87 (0.71, 1.06)	0.96 (0.81, 1.14)	0.93 (0.77, 1.13)	0.94 (0.8, 1.1)	0.88 (0.74, 1.04)	0.92 (0.76, 1.12)	0.84 (0.69, 1.03)
weekly or more ($N = 1306$)	**0.76 (0.63, 0.92)**	0.87 (0.71, 1.08)	**0.61 (0.50, 0.73)**	**0.74 (0.61, 0.91)**	**0.75 (0.64, 0.88)**	0.85 (0.71, 1.01)	0.87 (0.72, 1.05)	0.94 (0.76, 1.15)
Drinking amount per month during COVID-19 pandemic								
Never drink ($N = 1155$)	Reference							
<10 drinks ($N = 1146$)	0.91 (0.75, 1.10)	0.87 (0.71, 1.07)	0.93 (0.77, 1.11)	0.94 (0.77, 1.14)	0.89 (0.75, 1.05)	0.85 (0.72, 1.02)	0.87 (0.71, 1.06)	0.82 (0.67, 1.01)
≥10 drinks ($N = 1420$)	**0.81 (0.67, 0.98)**	0.87 (0.71, 1.07)	**0.65 (0.55, 0.78)**	**0.75 (0.62, 0.92)**	**0.80 (0.68, 0.93)**	0.87 (0.73, 1.03)	0.92 (0.76, 1.10)	0.94 (0.77, 1.16)
Binge drinking during COVID-19 pandemic								
Never binge drink ($N = 3080$)	Reference							
Ever binge drink ($N = 649$)	**1.57 (1.30, 1.89)**	1.12 (0.91, 1.38)	**1.63 (1.36, 1.96)**	**1.30 (1.06, 1.59)**	**1.60 (1.35, 1.90)**	**1.28 (1.06, 1.54)**	**1.41 (1.16, 1.71)**	1.09 (0.88, 1.34)

Bolded ORs are significant at the alpha level of 0.05. [a]Model adjusted for age, gender, race, education, income, COVID-19 infection history, smoking status, marital status, employment status and stay-at-home status.

Table 3. Stratified association between increased alcohol drinking behavior ($N = 837$) after COVID-19 pandemic and mental health symptoms compared with stable drinking behaviors ($N = 1478$)

	Anxiety	Depression	Stress	PTSD
Age[a]				
<30	1.34 (0.79, 2.27)	**2.18 (1.25, 3.78)**	**1.86 (1.06, 3.25)**	**1.74 (1.01, 2.98)**
30–59	**1.55 (1.19, 2.00)**	1.21 (0.94, 1.56)	**1.49 (1.18, 1.88)**	**1.66 (1.28, 2.16)**
≥60	1.26 (0.76, 2.10)	1.35 (0.86, 2.12)	1.11 (0.81, 1.53)	**2.06 (1.30, 3.25)**
P for interaction	0.4192	0.4184	0.1733	0.9616
Gender[a]				
Male	1.79 (0.99, 3.22)	**1.9 (1.09, 3.30)**	1.23 (0.80, 1.90)	1.54 (0.83, 2.86)
Female	**1.55 (1.23, 1.96)**	**1.44 (1.14, 1.81)**	**1.55 (1.27, 1.89)**	**1.90 (1.51, 2.40)**
P for interaction	0.7684	0.5267	0.3189	0.2511
Race[a]				
Non-Hispanic White	**1.59 (1.25, 2.01)**	**1.46 (1.15, 1.84)**	**1.48 (1.21, 1.80)**	**1.87 (1.48, 2.36)**
Other	**4.5 (1.37, 14.80)**	2.35 (0.91, 6.08)	**3.01 (1.33, 6.82)**	2.57 (0.96, 6.86)
P for interaction	0.3349	0.6237	0.0871[b]	0.3794
Social support[c]				
Moderate to strong	**1.69 (1.17, 2.46)**	**1.6 (1.12, 2.28)**	**1.52 (1.08, 2.13)**	1.44 (0.97, 2.13)
Poor	**1.45 (1.12, 1.89)**	**1.30 (1.01, 1.68)**	**1.40 (1.13, 1.73)**	**1.91 (1.49, 2.46)**
P for interaction	0.4553	0.5218	0.4871	0.3646
Worry about money[c]				
Not worried at all	1.39 (0.96, 2.01)	1.11 (0.78, 1.58)	1.26 (0.98, 1.62)	**1.70 (1.21, 2.38)**
A little bit or extremely worried	**1.57 (1.19, 2.06)**	**1.48 (1.14, 1.94)**	**1.59 (1.20, 2.12)**	**1.74 (1.31, 2.30)**
P for interaction	0.9925	0.3615	0.1874	0.7738
Worry about insurance[c]				
Not worried at all	**1.41 (1.06, 1.87)**	1.17 (0.89, 1.54)	**1.26 (1.02, 1.56)**	**1.67 (1.26, 2.21)**
A little bit or extremely worried	**1.60 (1.15, 2.24)**	**1.65 (1.19, 2.28)**	**1.79 (1.26, 2.55)**	**1.84 (1.31, 2.57)**
P for interaction	0.9689	0.2434	0.1189	0.6496
Worry about food and grocery items[c]				
Not worried at all	1.31 (0.97, 1.76)	1.04 (0.78, 1.37)	**1.28 (1.03, 1.59)**	**1.63 (1.23, 2.17)**
A little bit or extremely worried	**1.7 (1.23, 2.36)**	**1.86 (1.35, 2.56)**	**1.79 (1.26, 2.53)**	**1.92 (1.37, 2.68)**
P for interaction	0.4123	0.0256[b]	0.1415	0.5342
Stay-at-home status[d]				
No restriction; went to work/school regularly	1.25 (0.69, 2.25)	**1.87 (1.04, 3.37)**	1.51 (0.94, 2.42)	**1.83 (1.01, 3.33)**
Stayed at home most of the time but went to work/school sometimes	1.31 (0.74, 2.3)	1.05 (0.59, 1.85)	1.17 (0.77, 1.79)	1.49 (0.88, 2.52)
Stayed at home for work/school because of the recommendations	**1.63 (1.25, 2.14)**	**1.46 (1.12, 1.90)**	**1.5 (1.19, 1.89)**	**1.82 (1.39, 2.39)**
Stay at home due to exposure	3.55 (0.83, 15.22)	2.99 (0.77, 11.66)	3.2 (0.85, 12.10)	3.15 (0.95, 10.39)
P for interaction	0.6420	0.3921	0.5372	0.844

Bolded ORs are significant at the alpha level of 0.05. [a]Model adjusted for age (if age is not stratified), gender (if gender is not stratified), race (if race is not stratified), education, income, COVID-19 infection history, smoking status and employment status [b]*P* for interaction <0.10 [c]Model adjusted for age, gender, race, COVID-19 infection history and smoking status [d]Model adjusted for age, gender, race, education, income, smoking status and employment status

drinks or more had a significantly lower risk of depressive symptoms than non-drinkers, in line with the findings of another study that identified a decreased risk of depression symptoms among mild alcohol users compared with non-drinkers (Kim *et al*. 2021).

Our study also found that moderate alcohol consumption but not at the binge drinking level was associated with better mental health, whereas binge drinking over the course of the pandemic was associated with worse mental health symptoms, especially for depression and stress. A study consistent with our results suggested drinkers without alcohol abuse or dependence disorder have less severe depression and anxiety symptoms compared with non-drinkers (Zhong *et al*., 2019). On the other hand, the relationship between excessive drinking and adverse mental health performance has also been established in previous studies. For instance, alcohol use disorder is found to be comorbid with anxiety (Boschloo *et al*., 2012; Grant *et al*., 2015), depression (Boden & Fergusson 2011; Fergusson *et al*., 2009; Obeid *et al*., 2020), stress (Wemm *et al*., 2019; Zilberman *et al*., 2019; Mereish and Miranda, 2021) and PTSD (Lebeaut *et al*., 2020; Paltell *et al*., 2020; Tripp *et al*., 2020).

This is the first study to identify groups with stronger associations of alcohol consumption with mental health outcomes. Our study findings suggested that the associations between alcohol consumption behaviors and mental health issues vary by socioeconomic status and lifestyle changes during the pandemic. The positive associations between increased alcohol consumption since the COVID-19 pandemic and mental health disorders were stronger among racial minorities, those with worries about food and grocery items and those who stayed at home for work/school because of recommendations. The positive associations between binge drinking and mental health issues were stronger among females, those with poor social support and those who were worried about money, insurance or food and grocery items than their counterparts. These results suggested that differentiated COVID-19 impacts channeled through social determinants of health may even exacerbate the systematic disparities in public health. Existing studies have revealed that during the COVID-19 pandemic, those who are females, living in rural locations, experiencing loneliness, having a history of hospitalisation or had lost a job are more likely to experience adverse mental health symptoms (Kantor & Kantor, 2020; Wu *et al*., 2021). During the

Table 4. Stratified association between binge drinking during COVID-19 pandemic and mental health symptoms

		Anxiety	Depression	Stress	PTSD
Age[a]					
	<30	1.4 (0.92, 2.14)	1.32 (0.86, 2.03)	0.95 (0.61, 1.46)	1.04 (0.67, 1.63)
	30–59	1.04 (0.81, 1.34)	1.21 (0.95, 1.54)	1.15 (0.90, 1.48)	**1.46 (1.16, 1.84)**
	≥60	1.16 (0.66, 2.04)	1.54 (0.97, 2.43)	0.72 (0.38, 1.36)	1.13 (0.78, 1.64)
	P for interaction	0.3617	0.6686	0.2816	0.6464
Gender[a]					
	Male	0.95 (0.59, 1.54)	0.91 (0.58, 1.42)	0.49 (0.27, 0.86)	1.25 (0.86, 1.81)
	Female	1.17 (0.92, 1.47)	**1.38 (1.10, 1.73)**	**1.28 (1.02, 1.61)**	**1.29 (1.04, 1.6)**
	P for interaction	0.5381	0.0551[b]	0.7515	0.0006[b]
Race[a]					
	Non-Hispanic White	1.1 (0.87, 1.38)	**1.27 (1.02, 1.59)**	0.98 (0.78, 1.24)	1.21 (0.98, 1.48)
	Other	1.39 (0.43, 4.52)	1.74 (0.64, 4.76)	2.82 (0.97, 8.20)	**3.06 (1.10, 8.45)**
	P for interaction	0.8285	0.3824	0.5309	0.2256
Social support[c]					
	Moderate to strong	1.08 (0.84, 1.38)	1.13 (0.89, 1.44)	1.12 (0.88, 1.43)	1.18 (0.95, 1.47)
	Poor	1.15 (0.80, 1.65)	**1.56 (1.11, 2.18)**	0.92 (0.63, 1.34)	**1.57 (1.10, 2.23)**
	P for interaction	0.5952	0.1641	0.3058	0.3444
Worry about money[c]					
	Not worried at all	0.87 (0.60, 1.26)	1.01 (0.72, 1.41)	0.85 (0.59, 1.22)	1.03 (0.79, 1.34)
	A little bit or extremely worried	1.18 (0.91, 1.52)	**1.35 (1.05, 1.74)**	1.14 (0.88, 1.48)	**1.59 (1.19, 2.13)**
	P for interaction	0.2660	0.3514	0.0313[b]	0.1790
Worry about insurance[c]					
	Not worried at all	0.84 (0.63, 1.13)	1.1 (0.85, 1.43)	0.87 (0.65, 1.17)	1.14 (0.91, 1.43)
	A little bit or extremely worried	1.29 (0.95, 1.76)	1.31 (0.97, 1.77)	1.13 (0.83, 1.54)	1.34 (0.95, 1.90)
	P for interaction	0.0794[b]	0.6804	0.3420	0.0876[b]
Worry about food and grocery items[c]					
	Not worried at all	0.89 (0.66, 1.19)	1.12 (0.86, 1.47)	1.03 (0.77, 1.38)	1.22 (0.98, 1.52)
	A little bit or extremely worried	**1.39 (1.03, 1.9)**	**1.44 (1.07, 1.96)**	1.06 (0.78, 1.45)	**1.48 (1.03, 2.12)**
	P for interaction	0.0848[b]	0.1649	0.1909	0.8378
Stay-at-home status[d]					
	No restriction; went to work/school regularly	0.94 (0.55, 1.59)	1.05 (0.63, 1.73)	1.23 (0.72, 2.11)	**1.57 (1.02, 2.41)**
	Stayed at home most of the time but went to work/school sometimes	0.76 (0.44, 1.32)	0.91 (0.54, 1.52)	0.81 (0.48, 1.35)	0.91 (0.60, 1.40)
	Stayed at home for work/school because of the recommendations	1.28 (0.98, 1.68)	**1.42 (1.09, 1.83)**	1.15 (0.88, 1.51)	**1.36 (1.06, 1.75)**
	Stay at home due to exposure	0.92 (0.32, 2.64)	1.95 (0.71, 5.39)	1.11 (0.42, 2.91)	1.31 (0.43, 4.02)
	P for interaction	0.3932	0.3047	0.2197	0.7848

Bolded ORs are significant at the alpha level of 0.05. [a]Model adjusted for age (if age is not stratified), gender (if gender is not stratified), race (if race is not stratified), education, income, COVID-19 infection history, smoking status and employment status [b]*P* for interaction <0.10 [c]Model adjusted for age, gender, race, COVID-19 infection history and smoking status [d]Model adjusted for age, gender, race, education, income, smoking status and employment status

COVID-19 pandemic, the racial inequity and wealth gap were exacerbated due to health concerns and high unemployment (Ellis *et al*., 2021), and alterations in one's perceived financial situation mediated the impact of employment transition on mental health (Thomas *et al*., 2007). It has also been shown that a person's resilience to deal with difficulties or challenges in life can be significantly influenced by having satisfying social support (Schwab *et al*., 2022). In addition, in terms of gender inequity, a study revealed that mothers experienced higher levels of stress, lack of energy and loneliness than fathers did in the spring of 2020. As mothers suffered more from balancing their child care, housework and job responsibilities during the lockdown, and thus the gender gap in mental health was increased (Hiekel and Kühn, 2022). Moreover, this adverse effect of alcohol drinking patterns (initiating/ increasing alcohol consumption or binge drinking) also existed among people who stayed at home per recommendations or due to infection/exposure, which may be the result of lack of social activities or concerns of COVID-19.

We recruited a large sample of 3623 individuals from all the states in the USA except for Alaska, with age ranging from 18 to 96 years. This study was administered anonymously through online platforms, which minimised social-desirability bias in responses. We collected comprehensive demographic information, COVID-19 infection history and information about social behaviors during the pandemic, which allowed us to control confoundings and to identify potential effect modifiers.

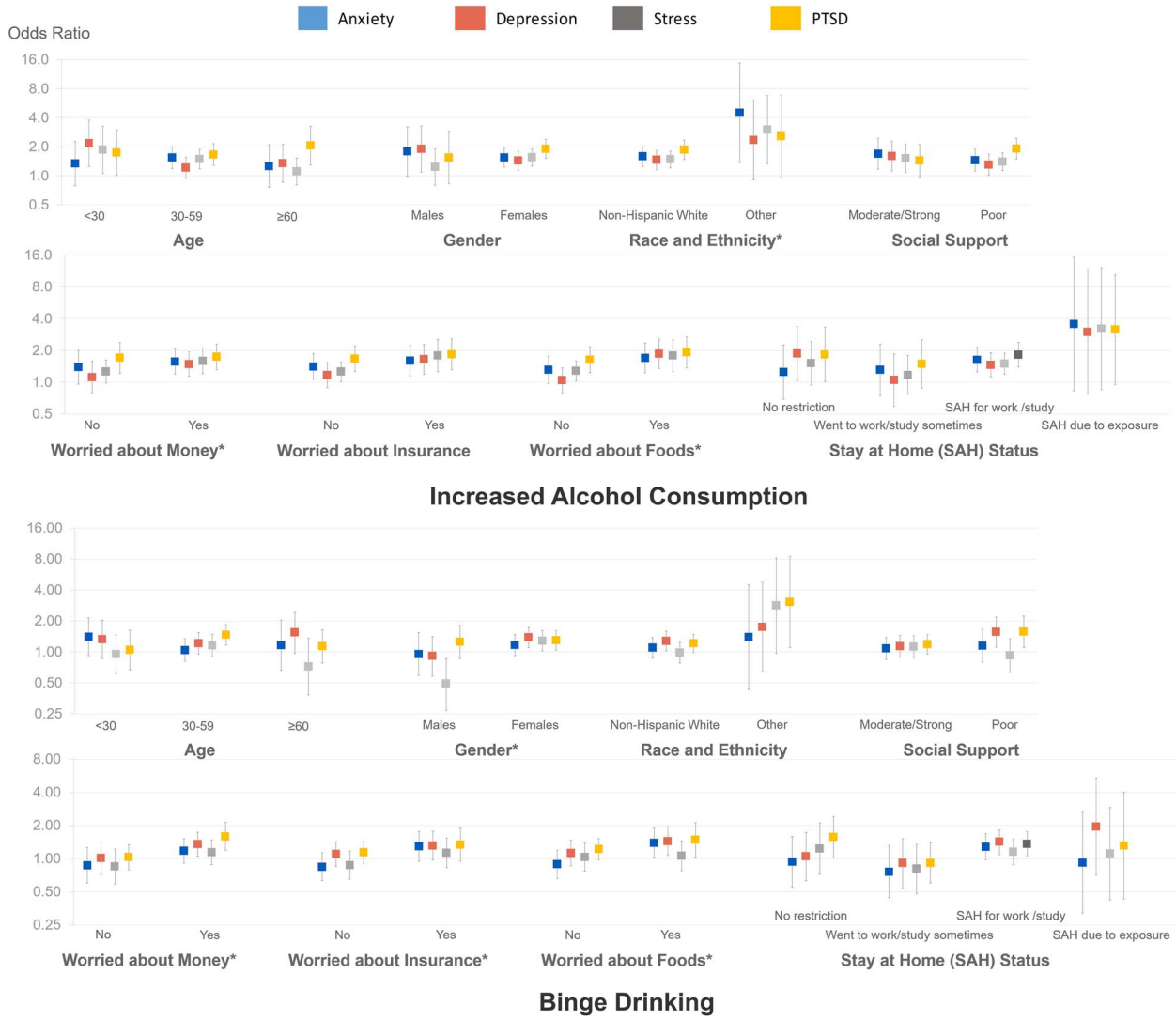

Fig. 1. Odds Ratios and 95% confidence intervals for stratified association of increased alcohol use and binge drinking with mental health disorders. Footnote: Among racial minorities, individuals with worries about money, and individuals with restricted stay-at-home status due to COVID-19 exposure, the association between increased alcohol use and adverse mental health symptoms appeared to be stronger than their counterparts. Among females, individuals with poor social support, and individuals with worries about money, insurance, food and grocery items, the association between binge drinking and adverse mental health symptoms appeared to be stronger than their counterparts. **P* for interaction <0.10.

However, this study has some limitations. Self-selection was likely because of the recruitment strategy. Participants in the study sample tended to be female-identified (78.9%), Caucasian (82.0%), middle class (33.4%) and highly educated, with college level or higher (79.9%), all of which may limit the generalisability of study results. Although the online questionnaire may have reduced social desirability bias, there are still likely errors in the report of both alcohol consumption and mental health symptoms. Further, because of the cross-sectional study design, we are unable to determine the temporal sequence of certain drinking patterns and the development of mental health status and therefore cannot draw a causal inference. It is possible that some other unmeasured factors may co-exist with both alcohol use and mental health symptoms. For instance, socially active individuals may use alcohol regularly, whereas they exhibit more resilience when confronted with mental health issues, but it was mental resilience that protected them from mental health problems rather than regular alcohol use. Nevertheless, this cross-sectional study identified susceptible populations to mental health disorders from a public health perspective, including those who increased their alcohol consumption or engaged in binge drinking during a pandemic phase. Therefore, more attention should be paid to these populations, especially for females, racial minorities, those with financial insecurities, those with poor social support and those with restricted staying-at-home status.

CONCLUSION

Alcohol drinkers who maintained their drinking habit appeared to have better mental health status compared with abstainers while people who increased their alcohol drinking consumption had higher odds of reported PTSD compared with those who maintained their pre-pandemic drinking habit. More frequent alcohol use and more consumption of alcohol per month were associated with lower odds of mental health disorders, but binge drinking over the course of the COVID-19 pandemic was associated with higher odds of mental health

disorders. From a public health perspective, mental health issues among those with increased alcohol consumption and binge drink may require more attention, especially for those who are minorities, female, with financial insecurities or with poor social support.

SUPPLEMENTARY MATERIAL

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

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AUTHOR CONTRIBUTIONS

Yihua Yue, Ella Smith, Zuo-Feng Zhang, Beth Smith, Lijian Lei, Lina Mu (Conceptualisation), Yihua Yue, Kexin Zhu, Zuo-Feng Zhang, Zhongzheng Niu, Lina Mu (Methodology), Yihua Yue (Data Analyses), Yihua Yue, Siyi Wang, Ella Smith, Divya Goyal (Writing—original draft), Zuo-Feng Zhang, Beth Smith, Jo L. Freudenheim, Jessica (Ying) Cao, Lina Mu (Writing —review and editing).

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY

The data underlying this article will be shared on reasonable request to the corresponding author.

References

Boden JM, Fergusson DM. (2011) Alcohol and depression. *Addiction* **106**:906–914. https://doi.org/10.1111/j.1360-0443.2010.03351.x.

Boschloo L, Vogelzangs N, van den Brink W *et al.* (2012) Alcohol use disorders and the course of depressive and anxiety disorders. *Br J Psychiatry* **200**:476–84. https://doi.org/10.1192/bjp.bp.111.097550.

Cohen S, Kamarck T, Mermelstein R. (1983) A global measure of perceived stress. *J Health Soc Behav* **24**:385–96.

Ellis C, Jacobs M, Keene KL *et al.* (2021) The impact of COVID-19 on racial-ethnic health disparities in the US: now is the time to address the problem. *J Natl Med Assoc* **113**:195–8. https://doi.org/10.1016/j.jnma.2020.08.008.

Fergusson DM, Boden JM, Horwood LJ. (2009) Tests of causal links between alcohol abuse or dependence and major depression. *Arch Gen Psychiatry* **66**:260–266. https://doi.org/10.1001/archgenpsychiatry.2008.543.

Grant BF, Goldstein RB, Saha TD *et al.* (2015) Epidemiology of DSM-5 alcohol use disorder: results from the National Epidemiologic Survey on alcohol and related conditions III. *JAMA Psychiat* **72**:757–66. https://doi.org/10.1001/jamapsychiatry.2015.0584.

Greenberg N, Weston D, Hall C *et al.* (2021) Mental health of staff working in intensive care during Covid-19. *Occup Med (Oxford, England)* **71**:62–7. https://doi.org/10.1093/occmed/kqaa220.

Hiekel N, Kühn M. (2022) Mental health before and during the COVID-19 pandemic: the role of partnership and parenthood status in growing disparities between types of families. *J Health Soc Behav* **63**:594–609. https://doi.org/10.1177/00221465221109195.

Jacob L, Smith L, Armstrong NC *et al.* (2021) Alcohol use and mental health during COVID-19 lockdown: a cross-sectional study in a sample of UK adults. *Drug Alcohol Depend* **219**:108488. https://doi.org/10.1016/j.drugalcdep.2020.108488.

Kessler RC, Chiu WT, Demler O *et al.* (2005) Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry* **62**:617–27. https://doi.org/10.1001/archpsyc.62.6.617.

Kim H, Yoo J, Han K, et al. (2021) Associations Between Smoking, Alcohol Consumption, Physical Activity and Depression in Middle-Aged Premenopausal and Postmenopausal Women. *Front Psychiatry* **12**:761761. https://doi.org/10.3389/fpsyt.2021.761761.

Kantor BN, Kantor J. (2020) Mental Health Outcomes and Associations During the COVID-19 Pandemic: A Cross-Sectional Population-Based Study in the United States. *Front Psychiatry* **11**:569083. https://doi.org/10.3389/fpsyt.2020.569083.

Kroenke K, Spitzer RL, Williams JB. (2001) The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* **16**:606–13. https://doi.org/10.1046/j.1525-1497.2001.016009606.x.

Lee BP, Dodge JL, Leventhal A, Terrault NA. (2021) Retail Alcohol and Tobacco Sales During COVID-19. *Ann Intern Med* **174**:1027–1029. https://doi.org/10.7326/M20-7271.

Lebeaut A, Tran JK, Vujanovic AA. (2020) Posttraumatic stress, alcohol use severity, and alcohol use motives among firefighters: the role of anxiety sensitivity. *Addict Behav* **106**:106353. https://doi.org/10.1016/j.addbeh.2020.106353.

Lechner WV, Laurene KR, Patel S *et al.* (2020) Changes in alcohol use as a function of psychological distress and social support following COVID-19 related university closings. *Addict Behav* **110**:106527. https://doi.org/10.1016/j.addbeh.2020.106527.

Lo CC, Cheng TC. (2018) Social status, discrimination, and minority individuals' mental health: a secondary analysis of US National Surveys. *J Racial Ethn Health Disparities* **5**:485–94. https://doi.org/10.1007/s40615-017-0390-9.

Mereish EH, Miranda R. (2021) A preliminary experimental study of minority stress, startle reactivity, and alcohol use among heavy drinking sexual minority young adults. *Subst Use Misuse* **56**:162–8. https://doi.org/10.1080/10826084.2020.1846197.

Mughal AY, Devadas J, Ardman E *et al.* (2020) A systematic review of validated screening tools for anxiety disorders and PTSD in low to middle income countries. *BMC Psychiatry* **20**:338. https://doi.org/10.1186/s12888-020-02753-3.

Nochaiwong S, Ruengorn C, Thavorn K, et al. (2021) Global prevalence of mental health issues among the general population during the coronavirus disease-2019 pandemic: a systematic review and meta-analysis. *Sci Rep* **11**:10173. https://doi.org/10.1038/s41598-021-89700-8.

Obeid S, Akel M, Haddad C, et al. (2020) Factors associated with alcohol use disorder: the role of depression, anxiety, stress, alexithymia and work fatigue- a population study in Lebanon. *BMC Public Health* **20**:245. https://doi.org/10.1186/s12889-020-8345-1.

Paltell KC, Smith RL, Kansky J *et al.* (2020) Posttraumatic stress disorder symptoms, relationship quality, and risky alcohol use among trauma-exposed students. *Addict Behav* **102**:106216. https://doi.org/10.1016/j.addbeh.2019.106216.

Pollard MS, Tucker JS, Green HD. (2020) Changes in adult alcohol use and consequences during the COVID-19 pandemic in the US. *JAMA Netw Open* **3**:e2022942. https://doi.org/10.1001/jamanetworkopen.2020.22942.

Prins A, Ouimette P, Kimerling R *et al.* (2003) The Primary Care PTSD Screen (PC-PTSD): development and operating characteristics. *Prim Care Psychiatry* **9**:9–14. https://doi.org/10.1185/135525703125002360.

Probst C, Kilian C, Sanchez S *et al.* (2020) The role of alcohol use and drinking patterns in socioeconomic inequalities in mortality:

a systematic review. *Lancet Public Health* **5**:e324–32. https://doi.org/10.1016/S2468-2667(20)30052-9.

Rudenstine S, Espinosa A, Kumar A. (2020) Depression and anxiety subgroups across alcohol use disorder and substance use in a National Epidemiologic Study. *J Dual Diagn* **16**:299–311. https://doi.org/10.1080/15504263.2020.1784498.

Schwab R, Stewen K, Kottmann T *et al.* (2022) Mental health and social support are key predictors of resilience in German women with endometriosis during the COVID-19 pandemic. *J Clin Med* **11**:3684. https://doi.org/10.3390/jcm11133684.

Smith L, Jacob L, Yakkundi A *et al.* (2020) Correlates of symptoms of anxiety and depression and mental wellbeing associated with COVID-19: a cross-sectional study of UK-based respondents. *Psychiatry Res* **291**:113138. https://doi.org/10.1016/j.psychres.2020.113138.

Spitzer RL, Kroenke K, Williams JBW *et al.* (2006) A brief measure for assessing Generalized Anxiety Disorder: the GAD-7. *Arch Intern Med* **166**:1092–7. https://doi.org/10.1001/archinte.166.10.1092.

Subbaraman MS, Mulia N, Kerr WC *et al.* (2020) Relationships between US state alcohol policies and alcohol outcomes: differences by gender and race/ethnicity. *Addiction* **115**:1285–94. https://doi.org/10.1111/add.14937.

Terlizzi EP, Villarroel MA. (2020) Symptoms of generalized anxiety disorder among adults: United States, 2019. *NCHS Data Brief* **378**:1–8.

Thomas C, Benzeval M, Stansfeld S. (2007) Psychological distress after employment transitions: the role of subjective financial position as a mediator. *J Epidemiol Community Health* **61**:48–52. https://doi.org/10.1136/jech.2005.044206.

Thompson K, Dutton DJ, MacNabb K *et al.* (2021) Changes in alcohol consumption during the COVID-19 pandemic: exploring gender differences and the role of emotional distress. *Health Promot Chronic Dis Prev Can* **41**:254–63. https://doi.org/10.24095/hpcdp.41.9.02.

Tripp JC, Worley MJ, Straus E *et al.* (2020) Bidirectional relationship of posttraumatic stress disorder (PTSD) symptom severity and alcohol use over the course of integrated treatment. *Psychol Addict Behav* **34**:506–11. https://doi.org/10.1037/adb0000564.

Villarroel MA, Terlizzi EP. (2020) Symptoms of depression among adults: United States, 2019. *NCHS Data Brief* **379**:1–8.

Volker D, Zijlstra-Vlasveld MC, Brouwers EPM *et al.* (2016) Validation of the Patient Health Questionnaire-9 for major depressive disorder in the occupational health setting. *J Occup Rehabil* **26**:237–44. https://doi.org/10.1007/s10926-015-9607-0.

Wemm SE, Larkin C, Hermes G *et al.* (2019) A day-by-day prospective analysis of stress, craving and risk of next day alcohol intake during alcohol use disorder treatment. *Drug Alcohol Depend* **204**:107569. https://doi.org/10.1016/j.drugalcdep.2019.107569.

WHO. 2020. *Alcohol Does Not Protect Against COVID-19; Access Should be Restricted during Lockdown*. Retrieved March 16, 2022 (https://www.euro.who.int/en/health-topics/disease-prevention/alcohol-use/news/news/2020/04/alcohol-does-not-protect-against-covid-19-access-should-be-restricted-during-lockdown).

Wu T, Jia X, Shi H, et al. (2021) Prevalence of mental health problems during the COVID-19 pandemic: A systematic review and meta-analysis. *J Affect Disord* **281**:91–98. https://doi.org/10.1016/j.jad.2020.11.117.

Zhong B-L, Yan-Min X, Xie W-X *et al.* (2019) Alcohol drinking in Chinese methadone-maintained clients: a self-medication for depression and anxiety? *J Addict Med* **13**:314–21. https://doi.org/10.1097/ADM.0000000000000500.

Zhu K, Niu Z, Freudenheim JL *et al.* (2021) COVID-19 related symptoms of anxiety, depression, and PTSD among US adults. *Psychiatry Res* **301**:113959. https://doi.org/10.1016/j.psychres.2021.113959.

Zilberman N, Yadid G, Efrati Y *et al.* (2019) Negative and positive life events and their relation to substance and behavioral addictions. *Drug Alcohol Depend* **204**:107562. https://doi.org/10.1016/j.drugalcdep.2019.107562.