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Alcohol Use Cravings as a Mediator Between Associated Risk Factors on Increased Alcohol Use among Youth Adults in New York During the COVID-19 Pandemic

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ABSTRACT

The sudden increase in alcohol use in the young-adult population during the COVID-19 pandemic may be partially explained by social isolation and stress due to restricted stay-at-home orders. The goal of this study was to assess specific psychological factors (e.g., anxiety, depressive symptoms, sleep disturbances, and alcohol cravings) and COVID-19 diagnoses and their association with increased alcohol use and misuse during the COVID-19 pandemic among New York residents ages 18–35 years. Survey data were collected via Qualtrics between July 2020 and October 2020. Path analysis tests were employed to test alcohol-use cravings as a mediator. Among the total sample ($N = 575$), the mean age was 27.94 ± 4.12 ; a majority of the participants were White non-Hispanic (66%), female (55%), and had completed a four-year college or university degree ($n = 249$; 43.5%). Results revealed that alcohol-use cravings was a significant mediator between sleep disturbances, having a COVID-19 diagnoses, and having mental-health symptoms on increased alcohol use. Our findings underscore the importance of providing resources for alcohol-use prevention and treatment in this unprecedented COVID-19 era. Policymakers, public-health professionals, and clinicians have a significant role in curbing the COVID-19-induced substance-use epidemic.

KEYWORDS

COVID-19; alcohol use; young adults; mental health; sleep

Alcohol misuse continues to be one of the nation's most preventable causes of death, second only to tobacco use and a poor diet/sedentary lifestyle (National Institute on Alcohol Abuse and Alcoholism, 2020). The emergence of COVID-19 has severely impacted and disrupted almost all aspects of life in the United States and around the world, possibly leading to a rise in alcohol misuse due to exposure of stressful conditions brought about by the COVID-19 pandemic. One of the first states to be affected greatly by the rapid transmission of COVID-19, was New York State, designated as the epicenter of the virus in March 2020 (Schuchat, 2020). At the start of the pandemic, new regulations such as stay-at-home orders and the

promotion of social distancing, were initiated to slow the spread of the coronavirus. While social distancing continues to be a necessary public-health measure to control disease spread in the wake of the COVID-19 pandemic, social distancing can increase social isolation and loneliness which in turn can lead to and or exacerbate psychological health problems (e.g., depression and anxiety).

According to recent evidence, stay-at-home-order measures have brought about an exorbitant increase in U.S. alcohol sales (Nielsen Company, 2020). This could be due to liquor stores being deemed as essential across most states in the United States, including New York state. Compared to one year prior, online alcohol sales rose more than 331% about two months after the COVID-19 pandemic was declared a public-health emergency in the United States on January 31, 2020 when compared to a year ago (U.S. Department of Health & Human Services, 2020). This increase in alcohol sales parallels the increase seen in adult alcohol consumption. Several studies have demonstrated that adults ages 18 years and older in the United States are consuming alcohol now in larger quantities, at harmful or dependent levels (e.g., binge drinking), and more frequently than before the COVID-19 pandemic (Boschuetz, Cheng, Mei, & Loy, 2020; Rodriguez, Litt, & Stewart, 2020; Sharma, Ebbert, Rosedahl, & Philpot, 2020). Although mitigation strategies such as stay-at-home orders may reduce SARS-CoV-2 transmission, stay-at-home orders have led to economic and other stressors such as many school and business closures, including restaurants, bars, and child-care centers, and to unemployment and financial insecurity for many Americans (Gostin & Wiley, 2020). These stressors among others may lead to unhealthy behaviors such as alcohol misuse as a way to cope (Sherman, Williams, Amick, Hudson, & Messias, 2020).

Stressful life events sometimes trigger psychological distress and negative emotions, which can then elicit a strong desire to consume alcohol, or alcohol craving as it is referred to in the literature (Keyes, Hatzembuehler, & Hasin, 2011). Several studies have shown that stress-induced negative emotions such as depressive and anxiety symptoms can predict high alcohol cravings and alcohol misuse (Clay et al., 2018). This has been shown to impact young adults both with and without a history of alcohol misuse; adults with mental-health problems or previous exposure to childhood stressors; sexual minorities (e.g., lesbian, gay, bisexual, or queer); and women with a harmful alcohol drinking pattern or alcohol dependency (Brooks et al., 2018; Hartwell & Ray, 2013; Mereish & Miranda, 2019; Soltis, McDevitt-Murphy, & Murphy, 2017). Abstinent alcohol-dependent adults exposed to stress imagery in a lab or real-life setting experience increased anxiety and alcohol craving and have a greater chance of alcohol relapse (Law et al., 2016; Neupert et al., 2017; Seo et al., 2013). Interestingly, other studies have shown that adults with no history of alcohol misuse or dependency are prone also to alcohol craving after exposure to stress imagery or a traumatic event. Moreover, sleep may play an important role in alcohol craving and misuse. Sleep disturbances (e.g., trouble falling and staying asleep) compromise mental-health functioning and impulse control, which elevates risk for heavy alcohol consumption (Hasler & Pedersen, 2020). Very few studies have examined the relationship between being diagnosed with COVID-19 and its influence on alcohol-use cravings, which can lead to an increase in alcohol use. This is an important area to explore as researchers are unaware of the impact of ongoing alcohol use and misuse for those with a history of COVID-19.

In regard to alcohol use during the COVID-19 crisis, a few studies have found that low social support and connectedness, loneliness, boredom, pandemic-related perceived threat, and elevated psychological distress (i.e., anxiety and depression) are linked to increased

alcohol use during the COVID-19 crisis (Avery et al., 2020; Rodriguez et al., 2020). Horigian, Schmidt, and Feaster (2020) found that American adults that feel lonelier or less socially connected during the pandemic experience more anxiety, which was directly related to increased alcohol use. Nonetheless, this finding only posits the directionality between loneliness, social connectedness, and anxiety on alcohol use, but does not assess potential intermediate factors such as alcohol cravings or increased alcohol use during stay-at-home orders.

Purpose of study

Using data collected from residents of New York, this study aimed to understand the relationship between increased alcohol use and misuse with associated risk factors during the COVID-19 pandemic using alcohol cravings as a mediator. This study also aims to shed light on young adults' vulnerability to alcohol use and misuse and outlines risk factors, such as having had COVID-19, mental health symptoms, and sleep disturbances that can possibly contribute to increased alcohol use and misuse during the COVID-19 pandemic.

Methods

This study was approved by the Stony Brook University Institutional Review Board. The study sample included ($N = 684$) participants that were surveyed using Qualtrics software. Eligibility criteria were as follows: 1) being between the ages of 18 and 35; 2) residing in New York at the time the stay-at-home orders were issued; and 3) being able to read and understand English. The survey was disseminated from July to October 2020 and recruitment occurred through social media channels, including email listservs, Facebook, and Twitter. Before proceeding to complete the survey, each participant consented to participate in the study by selecting "yes" to the question: "Do you agree to participate in this study?" All ($N = 684$) participants completed the survey. Participants who completed the survey received information about COVID-19 safety precautions and mental-health resources at the end of the survey and the first 270 participants received a US\$10 gift card (funding limitations prevented us from offering payment to the rest of the participants). The current study includes a delimited sample of ($n = 575$) of only participants who responded "yes" to alcohol consumption questions ($N = 575$).

Measures

Outcome variable

Data were collected via Qualtrics online survey tool. *Data concerning increased alcohol use due to the New York COVID-19 stay-at-home orders* were collected using a single-item question (*Has your drinking increased since New York issued stay-at-home orders?*) from the CDC's COVID-19 Community Response Survey Module 10 (Johns Hopkins University, 2020).

Predictor variables

The survey included sociodemographic questions (age, race/ethnicity, gender, sexuality, campus enrollment, academic standing, employment), *COVID-19 diagnosis* prior to being surveyed (Yes = 1 or No = 0); the Patient Health Questionnaire-9 (PHQ-9), a validated measure of

depression severity and suicidal ideations having occurred in the past two weeks (Kroenke, Spitzer, & Williams, 2001; Lowe et al., 2008). The PHQ-9 was scored according to standard guidelines (Löwe et al., 2008 & Spitzer, Kroenke, Williams, & Löwe, 2006). Raw PHQ-9 scores range from 0 to 27 ($M = 10.04 \pm 5.29$) and were used to categorize depression severity: mild (5–9), moderate (10–14), moderately severe (15–19), or severe (≥ 20). Alcohol cravings data were collected using the five-item Penn Alcohol Craving Scale (PACS), a validated measure used to assess an individual's craving to drink alcohol (Flannery, Volpicelli, & Pettinati, 1999). Sleep disturbances data were collected using the Sleep Insomnia Severity Index, a validated seven-item measure to examine individuals' disturbances in sleep including insomnia (Morin, Belleville, Bélanger, & Ivers, 2011). A total raw score was calculated for alcohol cravings and sleep disturbances (Flannery et al., 1999; Morin et al., 2011).

Data analysis

Only participants who answered questions on alcohol consumption were included in data analyses ($N = 575$). Demographic data were presented descriptively. Since responses were not required, some demographic data were missing. Little's Missing Completely at Random (MCAR) test was used to assess the level and type of missingness (Little & Rubin, 2019). This test revealed that data were likely MCAR ($\chi^2 = 59.95 [15], p = .12$). Further inspection of data revealed that the largest number of missing data (12%) was related to depression severity (PHQ-9) and alcohol cravings, which is not surprising given the sensitivity of the questions. Although numerous missing data techniques are available (McGinniss & Harel, 2016), missing data were handled using a chained imputation approach in STATA. Normality and the presence of outliers were examined, with skew and kurtosis within normal distribution ranges and no conspicuous outliers noted. Multicollinearity were examined and variables were within the designated parameter ranges for variance inflation factor (< 10) and tolerance (> 0.2).

Chi-square tests were conducted between sociodemographic characteristics and the outcome variable, *increased alcohol use due to the New York COVID-19 stay-at-home orders*. In addition, we used chi-square tests to determine significant differences between clinically relevant predictors including depression severity and COVID-19 diagnosis on increased alcohol use. Independent sample *t*-tests were conducted between the outcome of interest and clinically relevant predictors including raw alcohol-use-cravings scores and raw sleep-disturbances scores. Last, structural equation modeling (SEM) techniques in STATA were conducted to examine a mediation path model between depression severity, COVID-19 diagnosis, sleep severity, and increased alcohol use due to the New York COVID-19 stay-at-home. Maximum likelihood (ML) estimations were used to examine the variance-covariance matrix. Mediation was tested using bias-corrected bootstrap confidence intervals, which provide more-accurate intervals (Mallinckrodt et al., 2006). Bias-corrected bootstrap confidence intervals also improve the power of the test of the indirect effect (Shrout & Bolger, 2002). A significant indirect effect is present when confidence intervals do not include zero (Hayes, 2009). Sociodemographic variables with a $p \leq .20$ were chosen as covariates (Bursac, Gauss, Williams, & Hosmer, 2008) and retained based on meaningful contribution and statistical significance to the final analytical model (Aneshensel, 2013).

Model-fit indices were examined as the mediation path model was generated. Model fit was considered good if the chi-square (χ^2) value was nonsignificant ($p \geq 0.05$), though χ^2

alone can be sensitive to sample size (West et al., 2012). Therefore, additional indices of model fit were considered. Good model-to-data fit was assumed if the comparative fit index (CFI) and goodness-of-fit index (GFI) were $\geq .95$ (adequate if $\geq .90$), the incremental fit index (IFI) was $\geq .90$ (though the index can exceed 1), and the root mean square error of approximation (RMSEA) was $\leq .06$ (adequate if $\leq .09$) (West et al., 2012). Bollen-Stine bootstrap procedures with 6,000 bootstrap resamples were also used to assess the consistency of the proposed model to the sample data. Bollen-Stine bootstrap results with a p -value greater than .05 indicates that the proposed model is consistent with the sample data (Walker & Smith, 2017).

Estimating power for mediation-path models is complex because study design, level of missing data, scaling, estimator type, and model complexity need to be considered and may vary widely (Walker & Smith, 2017). Literature shows that sample sizes between 150 and 200 participants are appropriate for simple mediation-path analysis models (Iacobucci, 2010). Other studies have proposed varying requirements for sample size based on the number of observations to parameter estimates, ranging from 20 observations (participants) to each estimated parameter (Kline, 2015) to as low as 10 observations (participants) to each estimated parameter (Schreiber et al., 2006). Based on the 15 parameters estimated in this study, the sample size of 575 is adequate to identify indirect effects (Iacobucci, 2010; Thoemmes et al., 2010).

Results

Sociodemographic differences

Sociodemographic characteristics, COVID-19 diagnosis, and between-group analysis on increased alcohol use due to the New York COVID-19 stay-at-home orders. The average age of participants was 27.94 ± 4.12 with 77.2% of participants between 25 and 34 years of age. As shown in Table 1, participants were predominantly female ($n = 317$; 55.6%); were White non-Hispanic ($n = 380$; 66.1%); were straight/heterosexual ($n = 528$; 93.3%); and had completed a 4-year college or university degree ($n = 249$; 43.5%). Most respondents had an annual income between 20,000 USD and 49,999 USD ($n = 224$; 39.9%) and US\$50,000 and US\$99,999 ($n = 230$; 41.0%). At the time of being surveyed, 50% of the participants were employed full-time ($n = 287$; 50.2%) and 83.9% of the participants had access to health insurance ($n = 479$). Nearly a quarter of participants ($n = 134$; 23.4%) had had a positive COVID-19 diagnosis.

Several between-group differences were identified on the outcome of increased alcohol use due to the New York COVID-19 stay-at-home orders. For instance, a slightly higher number of male participants ($n = 64$; 51.6%) indicated that their alcohol use increased compared to females ($n = 60$; 48.4%). A larger percentage of those who indicated that their alcohol use increased were not employed but were looking for work (21.0%) compared to those who indicated that their alcohol use did not increase (14.5%). In addition, while most participants had health insurance, a slightly larger percentage of those without health insurance (19.2%) indicated that their alcohol use increased compared to those who indicated that their alcohol use did not increase (15.2%). Moreover, of the 23.4% participants who had a positive COVID-19 diagnosis, 47.2% said their drinking increased compared to 16.7% who said that their drinking did not increase.

Table 1. Sociodemographic characteristics, COVID-19 diagnosis, depression and suicidal ideations, and between-group analysis on increased alcohol use ($N = 575$).

Demographics	Increased alcohol use due to the New York COVID-19 stay-at-home orders		χ^2	df	p-value
	No	Yes			
Total sample	575	126			
Age ($M = 27.94 \pm 4.12$)			5.96	2	.06
18–24	122 (21.2%)	19			15.1%
25–34	444 (77.2%)	103			81.7%
35+	9 (1.6%)	4			3.2%
Gender			3.35 ^a	1	< .001
Male	253 (44.4%)	64			51.6%
Female	317 (55.6%)	60			48.4%
Race/ethnicity					
American Indian/ Alaskan Native	27 (4.7%)	0	7.95	1	.005
Asian	45 (7.8%)	11	.18	1	.67
Black/African American	117 (20.3%)	29	.71	1	.40
Hispanic, Latino, or Spanish	140 (24.5%)	44	9.53 ^a	1	.33
White non-Hispanic	380 (66.1%)	83	.03	1	.95
Government/social service financial assistance			3.36	2	.18
No	27 (12.9%)	9			13.6%
Yes	165 (78.9%)	55			83.3%
In process	17 (8.1%)	2			3.0%
Income			7.30	3	.10
Less than \$20,000	75 (13.4%)	66			7.2%
\$20,000–\$49,999	224 (39.9%)	176			38.4%
\$50,000–\$99,999	230 (41.0%)	172			46.4%
\$100,000 +	32 (5.7%)	22			8.0%
Sexuality			5.03	3	.17
Straight (heterosexual)	528 (93.3%)	417			41.7%
Gay, lesbian, queer	16 (2.8%)	10			10
Bisexual	18 (3.2%)	12			12
Other/questioning	4 (0.7%)	4			4
Education			8.29	5	.14
High school graduate	28 (4.9%)	25			2.4%
Some college	142 (24.8%)	113			23.2%
2-year associate degree	93 (16.2%)	67			20.8%
4-year college or university degree	249 (43.5%)	201			38.4%
Some postgraduate or professional education	32 (5.6%)	22			8.0%
Postgraduate or professional degree received	29 (5.1%)	20			7.2%
Employment status			15.25	5	.006

(Continued)

Table 1. (Continued).

Demographics	Increased alcohol use due to the New York COVID-19 stay-at-home orders				X ²	df	p-value
	No	Yes	No	Yes			
Employed, full-time	287	50.2%	229	51.1%			
Employed, part-time	138	24.1%	103	23.0%			46.8%
Not employed, looking for work	91	15.9%	65	14.5%			28.2%
Not employed, not looking for work	32	5.6%	29	6.5%			21.0%
Unable to work	21	3.7%	21	4.7%			2.4%
On unpaid leave	3	0.5%	1	0.2%			0.0%
Health insurance							1.6%
No	92	16.1%	68	15.2%		1	< .001
Yes	479	83.9%	378	84.8%			
COVID-19 diagnosis							
No	439	76.6%	373	83.3%		1	< .001
Yes	134	23.4%	75	16.7%			
Depression severity (M = 10.04 ± 5.29)							
No depression	88	17.8%	81	21.6%			
Mild depression	143	28.9%	121	32.3%			5.8%
Moderate depression	173	34.9%	130	34.7%			18.3%
Moderately severe depression	69	13.9%	36	9.6%			35.8%
Severe depression	22	4.4%	7	1.9%			27.5%
Suicidal ideations							12.5%
Not at all	238	46.3%	202	52.1%		1	< .001
Several days	156	30.4%	120	30.9%			28.6%
Over half of the days	99	19.3%	57	14.7%			28.6%
Nearly every day	21	4.1%	9	2.3%			33.3%

^aMcNemar chi-square test

Table 2. Mean level differences between increased alcohol use and clinically relevant predictors ($N = 579$).

	Increased alcohol use due to the New York COVID-19 stay-at-home orders				t (569)	p - value	Cohen's d	CI 95%
	No		Yes					
	Mean	SD	Mean	SD				
Alcohol cravings	12.01	4.52	17.28	4.46	-8.78	< .001	-1.17	-1.45, -.88
Sleep disturbances	6.65	2.32	9.14	2.76	-10.16	< .001	-1.03	-1.23, -.82

SD = standard deviation; CI = confidence interval.

Depression severity, suicidal ideations, and-between group analyses on increased alcohol use due to the New York COVID-19 stay-at-home orders

The mean raw PHQ-9 score to measure depression severity was 10.04 ± 5.29 (see Table 1). Among participants who responded to depression severity questions, the majority had either mild ($n = 142$; 28.9%), moderate ($n = 173$; 34.9%), or moderately severe depression ($n = 69$; 13.9%). Significant between-group differences were identified on depression severity and the outcome of increased alcohol use due to the New York COVID-19 stay-at-home orders ($X^2(4) = 62.88$, $p < .001$). For example, among those participants who reported that their alcohol use increased, 27.5% had moderately severe depression and 12.5%, severe depression compared to the participants who reported that their alcohol use did not increase (9.6% and 1.9%, respectively). Among all participants, 53.7% reported having had suicidal ideations prior to being surveyed, and among those who indicated that their alcohol use increased, approximately 72% reported having had suicidal ideations.

Mean level differences between increased alcohol use due to the New York COVID-19 stay-at-home orders and clinically relevant predictors

Several additional mean-level group differences were identified among clinically relevant predictors and the outcome of interest (see Table 2). Mean level raw alcohol-cravings scores showed a significant between-group difference among those who identified that their alcohol use increased ($M = 17.28 \pm 4.46$) compared to those who said it did not increase ($M = 12.01 \pm 4.52$). Effect size for alcohol cravings indicated a difference greater than one standard deviation ($d = -1.17$, 95% CI = $-1.45, -.88$). Significant mean level differences on the raw scores for average drinks per day were also identified among those who reported that their alcohol use increased ($M = 4.46 \pm 4.75$) compared to those who said it did not increase ($M = .63 \pm 1.74$). Effect size for average drinks per day indicated a difference greater than one standard deviation ($d = -1.41$, 95% CI = $-1.62, -1.20$). Last, significant mean level differences on the raw sleep-disturbance score were noted among those who reported that their alcohol use increased ($M = 9.14 \pm 2.75$) compared to those who said it did not increase ($M = 6.65 \pm 2.32$). Effect size for sleep disturbances indicated that the difference was greater than one standard deviation ($d = -1.03$, 95% CI = $-1.23, -.82$).

Mediation-path model

Figure 1 presents the over-identified path model, with standardized regression weights reported. Table 3 presents both standardized and unstandardized regression weights for the model. This model tested the mediating influence of alcohol cravings between depression,

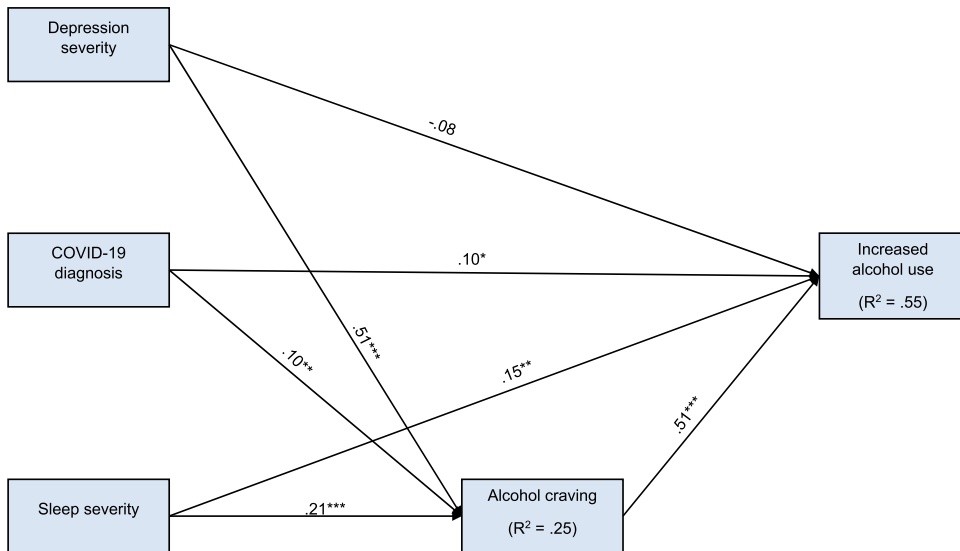


Figure 1. Mediation-path analysis model: Depression severity, COVID-19 diagnosis, and sleep severity on increased alcohol use due to the New York COVID-19 stay-at-home orders through alcohol cravings. *Note.* Standardized beta weights presented. Model fit: $\chi^2 (df = 1) = 1.03, p = .13$; GFI = .99; AGFI = .98; CFI = .98; IFI = .98; RMSEA = .007 (95% CI = .001, .08). Bollen-Stine bootstrapping results showed that the p -value was greater than .05 ($p = .35$). Covariates included individual income. GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; CFI = comparative fit index; IFI = incremental fit index; RMSEA = root mean square error of approximation; CI = confidence interval; Increased alcohol use = increased alcohol use due to the New York COVID-19 stay-at-home orders.

Table 3. Unstandardized and standardized coefficients and significance levels for main analytic mediation model ($N = 579$).

Parameter estimates	Unstandardized regression weights		Standardized regression weights
Structural model			
Depression severity → Increased alcohol use	-.01	(.004)	-.08
COVID-19 diagnosis → Increased alcohol use	.08	(.04)	.10*
Sleep severity → Increased alcohol use	.02	(.01)	.15**
Alcohol cravings → Increased alcohol use	.05	(.01)	.51***
Depression severity → Alcohol cravings	.34	(.03)	.45***
COVID-19 diagnosis → Alcohol cravings	.86	(.31)	.10**
Sleep severity → Alcohol cravings	.31	(.06)	.21***
Covariate			
Individual income → Alcohol cravings	.83	(.15)	.17***

Note. Standard errors are shown in parentheses. Model fit: $\chi^2 (df = 1) = 1.03, p = .13$; GFI = .99; AGFI = .98; CFI = .98; IFI = .98; RMSEA = .007 (95% CI = .001, .08). Bollen-Stine bootstrapping results showed that the p -value was greater than .05 ($p = .35$). Covariates included individual income. GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; CFI = comparative fit index; IFI = incremental fit index; RMSEA = root mean square error of approximation; CI = confidence interval; Increased alcohol use = Increased alcohol use due to the New York COVID-19 stay-at-home orders.

a positive COVID diagnosis, and sleep severity on increased alcohol use due to the New York COVID-19 stay-at-home orders. Individual income was retained as a covariate in the final model. The unconstrained mediation-path model demonstrated good fit: $\chi^2 (df = 1) = 1.03, p = .13$; GFI = .99; AGFI = .98; CFI = .98; IFI = .98; RMSEA = .007 (95% CI = .001, .08). Bollen-Stine bootstrapping results showed that the p -value was greater than .05 ($p = .35$), indicating that the model was consistent with the sample data. This model

accounted for 55% of the variance in alcohol cravings and 25% of the variance in the outcome increased alcohol use due to the New York COVID-19 stay-at-home orders.

A positive direct association was present between depression and alcohol cravings ($\beta = .45, p < .001$), COVID-19 diagnosis, and alcohol cravings ($\beta = .11, p < .01$), and sleep severity and alcohol cravings ($\beta = .21, p < .001$). As a covariate, individual income was positively associated with alcohol cravings ($\beta = .17, p < .001$). COVID-19 diagnosis ($\beta = .10, p < .05$), sleep severity ($\beta = .15, p < .01$), and alcohol cravings ($\beta = .51, p < .001$) were positively associated with increased alcohol use due to the New York COVID-19 stay-at-home orders. Using bias-corrected bootstrap CIs, the following partial indirect associations through alcohol cravings were significant ($p < .05$): depression and increased alcohol use due to the New York COVID-19 stay-at-home orders (indirect effect: .23, 95% CI = .19, .28); COVID-19 diagnosis and increased alcohol use due to the New York COVID-19 stay-at-home orders (indirect effect: .05, 95% CI = .02, .08); and sleep severity and increased alcohol use due to the New York COVID-19 stay-at-home orders (indirect effect: .11, 95% CI = .08, .15). Alcohol cravings mediated 57% of the association between depression and increased alcohol use due to the New York COVID-19 stay-at-home orders, 51% of the association between COVID diagnosis and increased alcohol use due to the New York COVID-19 stay-at-home orders, and 50% of the association between sleep severity and increased alcohol use due to the New York COVID-19 stay-at-home orders.

Discussion

The primary aim of this study was to test the hypothesis that during the COVID-19 stay-at-home orders, alcohol-use cravings mediated the relationship between mental-health symptoms, sleep disturbances, and COVID-19 diagnoses on increased alcohol use. The literature has reported that alcohol use and misuse is often exacerbated by traumatic experiences (e.g., sexual assault, childhood trauma, exposure to other violence or natural disasters; Black et al., 1970; Craner, Martinson, Sigmon, & McGillicuddy, 2015). Since alcohol use and misuse can lead to serious health complications, it is essential to understand the risk factors present that can exacerbate alcohol use during a crisis. First, alcohol-use cravings significantly predicted alcohol-use increase as reported by participants. Alcohol-use cravings is a reliable predictor of alcohol misuse in both nontreatment and treatment-seeking settings including among heavy-drinking adults and adolescents (Tidey et al., 2007). Stressful events, such as the COVID-19 pandemic, have been found to affect alcohol-use cravings following exposure to a traumatic event. However very little research has aimed to understand how cravings are impacted through long lasting, global events such as the COVID-19 pandemic.

Participants who had an increase in their alcohol use had higher levels of anxiety. This is consistent with literature that has demonstrated an association between anxiety symptoms due to the exposure of a traumatic event or natural disaster and alcohol use and misuse (Smith & Cottler, 2018). Psychological distress has been found to precipitate alcohol use, as individuals, especially those who are social or heavy drinkers, may use alcohol to manage or cope with their anxiety (Clay et al., 2018). Among young adults, who have the highest rates of drinking, studies have indicated that anxiety is closely related to alcohol use as a way to cope (Hingson, Heeren, Edwards, & Saitz, 2011). While this study did not ask participants

to reveal their motivations for drinking, the association between anxiety and increased alcohol use is consistent with patterns of behaviors during pandemics (Stanton et al., 2020).

Sleep disturbances had a strong association with increased alcohol use among the sample, mediated by alcohol cravings. Plausible explanations for this finding exist. Sleep problems undermine self-regulation and diminish cognitive control over negative emotions and impulses, which may contribute to mental-health conditions including anxiety (Hasler & Pedersen, 2020; Schmidt, Harvey, & Van Der Linden, 2011). This process, in turn, may elevate the likelihood of risky coping strategies including heavy alcohol consumption (Hasler & Pedersen, 2020).

Surprisingly, this study revealed that participants who reported being diagnosed with COVID-19 had a direct positive association of increased alcohol use mediated by alcohol-use cravings. This is an important finding as several federal agencies including the National Institute on Alcohol Abuse and Alcoholism (2020) have urged individuals to not use alcohol if they have been diagnosed with COVID-19. This finding can be explained by the association of mental-health symptoms, mainly anxiety, involving having COVID-19, which may exacerbate stress, increase alcohol-use cravings as a way to cope with stress, and lead to higher use of alcohol.

Limitations and implications

While this study has many strengths, there are limitations present. First, this study employs a cross-sectional, convenience sample design. Therefore, it is possible that the findings may not be generalizable to all young adults aged 18–35 years of age in the United States. Furthermore, causality cannot be inferred from our findings. We encourage more investment in longitudinal research specifically examining alcohol use and potential misuse among populations that have been affected and diagnosed with COVID-19 over time. In addition, no attempt was made to understand motivations regarding increased alcohol use due to stay-at-home orders in this study. Qualitative research may be helpful to promote understanding of this association and reveal additional reasons for increased alcohol use occurred during the stay-at-home orders.

To effectively mitigate risks in case of a future pandemic, it is important that prevention efforts be employed to alleviate such risks. While there is evidence that indicates that social distancing measures are effective and save lives, this study provides preliminary evidence for the possible secondary health effects of isolation due to stay-at-home orders and the impact on alcohol use and cravings. This study provides important implications for future alcohol-use-and-misuse research, treatment, and prevention. Cognitive behavioral treatments have traditionally addressed alcohol-use craving; however, craving can be different based on being in a stress-induced craving state that may encompass physiologic, emotional, cognitive, and behavioral aspects of stress-related alcohol and drug motivation to potentially impact risk of intake (Bergquist, Yutsis, & Sullan, 2015; Sinha & Jastreboff, 2013). More evidence is needed to understand how stressful global events such as the sudden arrival of COVID-19 has on alcohol-use cravings and preventive measures that can be in place to alleviate any potential risk. Our study findings are particularly relevant among individuals ages 18 to 35 years as this age-group has a high prevalence of binge drinking and depression compared with older age groups (Centers for Disease Control and Prevention, 2020; Esser, Pickens, Guy, & Evans, 2021). With more than a third of the labor force being Millennials (persons age 21 to

35 years), our finding has important economic implications. The trauma from either being exposed to COVID-19 or living through the pandemic and increased alcohol cravings and consumptions can lead to poor performance at work, reduced income, and job loss, which are factors that contribute to deaths of despair among middle-age Americans (Copeland et al., 2020; Fry, 2020). Therefore, from a prevention standpoint, approaches that help address COVID-19–related factors that drive alcohol cravings and consumption are immediately needed. Ramping up COVID-19 vaccination broadly in the population can support the reopening of the economy and return to work (for those who lost their jobs/wages), which could help reduce the social isolation and loneliness that drive alcohol use. At an individual level, clinicians can prioritize alcohol screening during encounters to promptly identify patients with alcohol misuse and refer them to treatment.

The relationship between mental-health symptoms, including anxiety, and substance use has been established in the literature. This study confirms such results and encourages clinicians to urge alcohol-craving prevention strategies, anxiety-reducing techniques, and strategies to promote better sleeping habits, which can all possibly alleviate increased alcohol use during the pandemic and beyond.

Conclusion

Researchers can infer that the COVID-19 pandemic has caused psychological issues pertaining to mental health, such as anxiety and depressive symptoms, due to the increased amount of stress and uncertainty the pandemic presented. Mental-health issues often serve as an underlying problem that either exacerbates alcohol use or precedes it. It is essential for policymakers and researchers to provide resources in mental-health prevention as this is predicted to become a long-term consequence of the COVID-19 pandemic. The current crisis provides an opportunity to align mental-health-care policies with the current state of knowledge regarding the effectiveness of mental-health options that can incorporate coping mechanisms that individuals can utilize to improve their health outcomes.

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Data availability statement

Data and materials are available upon request only. Availability data codes are not available.

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References

- Aneshensel, C. (2013). *Theory-based data analysis for the social sciences*. doi:10.4135/9781506335094
- Avery, A. R., Tsang, S., Seto, E. Y., & Duncan, G. E. (2020). Stress, anxiety, and change in alcohol use during the COVID-19 pandemic: Findings among adult twin pairs. *Frontiers in Psychiatry, 11*. doi:10.3389/fpsy.2020.571084
- Bergquist, T. F., Yutsis, M., & Sullan, M. J. (2015). Satisfaction with cognitive rehabilitation delivered via the internet in persons with acquired brain injury. *International Journal of Telerehabilitation, 39*–50. doi:10.5195/ijt.2014.6142
- Black, M., Basile, K., Breiding, M., Smith, S., Walters, M., Merrick, M., . . . Stevens, M. (1970, January 1). *National intimate partner and sexual violence survey: 2010 summary report*. CVR Repository Home. Retrieved from <https://ncvc.dspacedirect.org/handle/20.500.11990/250> .
- Boschuetz, N., Cheng, S., Mei, L., & Loy, V. M. (2020). Changes in alcohol use patterns in the United States during COVID-19 pandemic. *WMJ: Official Publication of the State Medical Society of Wisconsin, 119*(3), 171–176.
- Brooks, A. T., Krumlau, M., Beck, K. H., Fryer, C. S., Yang, L., Ramchandani, V. A., & Wallen, G. R. (2018). A mixed methods examination of sleep throughout the alcohol recovery process grounded in the social cognitive theory: The role of self-efficacy and craving. *Health Education & Behavior, 46*, (1), 126–136. doi:10.1177/1090198118757820
- Bursac, Z., Gauss, C. H., Williams, D. K., & Hosmer, D. W. (2008). Purposeful selection of variables in logistic regression. *Source Code for Biology and Medicine, 3*(1). doi:10.1186/1751-0473-3-17
- Centers for Disease Control and Prevention. (2020, July 27). *Binge drinking*. Retrieved from <https://www.cdc.gov/alcohol/fact-sheets/binge-drinking.htm#:~:text=Binge%20drinking%20is%20most%20common,those%20aged%2035%20and%20older.&text=Binge%20drinking%20is%20twice%20as,drinks%20are%20consumed%20by%20men>
- Clay, J. M., Adams, C., Archer, P., English, M., Hyde, A., Stafford, L. D., & Parker, M. O. (2018). Psychosocial stress increases craving for alcohol in social drinkers: Effects of risk-taking. *Drug and Alcohol Dependence, 185*, 192–197. doi:10.1016/j.drugalcdep.2017.12.021
- Copeland, W. E., Gaydosh, L., Hill, S. N., Godwin, J., Harris, K. M., Costello, E. J., & Shanahan, L. (2020). undefined. *JAMA Network Open, 3*(6), e208627. doi:10.1001/jamanetworkopen.2020.8627
- Craner, J. R., Martinson, A. A., Sigmon, S. T., & McGillicuddy, M. L. (2015). Prevalence of sexual trauma history using behaviorally specific methods of assessment in first year college students. *Journal of Child Sexual Abuse, 24*(5), 484–505. doi:10.1080/10538712.2015.1026014
- Esser, M. B., Pickens, C. M., Guy, G. P., & Evans, M. E. (2021). Binge drinking, other substance use, and concurrent use in the U.S., 2016–2018. *American Journal of Preventive Medicine, 60*(2), 169–178. doi:10.1016/j.amepre.2020.08.025
- Flannery, B. A., Volpicelli, J. R., & Pettinati, H. M. (1999). Psychometric properties of the Penn alcohol craving scale. *Alcoholism: Clinical and Experimental Research, 23*(8), 1289–1295. doi:10.1111/j.1530-0277.1999.tb04349.x
- Fry, R. (2020, July 27). *Millennials are largest generation in the U.S. labor force*. Retrieved from <https://www.pewresearch.org/fact-tank/2018/04/11/millennials-largest-generation-us-labor-force/>
- Gostin, L. O., & Wiley, L. F. (2020). Governmental public health powers during the COVID-19 pandemic. *JAMA, 323*(21), 2137. doi:10.1001/jama.2020.5460

- Hartwell, E. E., & Ray, L. A. (2013). Sex moderates stress reactivity in heavy drinkers. *Addictive Behaviors*, 38(11), 2643–2646. doi:10.1016/j.addbeh.2013.06.016
- Hasler, B. P., & Pedersen, S. L. (2020). Sleep and circadian risk factors for alcohol problems: A brief overview and proposed mechanisms. *Current Opinion in Psychology*, 34, 57–62. doi:10.1016/j.copsyc.2019.09.005
- Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication monographs*, 76(4), 408–420.
- Hingson, R. W., Heeren, T., Edwards, E. M., & Saitz, R. (2011). Young adults at risk for excess alcohol consumption are often not asked or counseled about drinking alcohol. *Journal of General Internal Medicine*, 27(2), 179–184. doi:10.1007/s11606-011-1851-1
- Horigian, V. E., Schmidt, R. D., & Feaster, D. J. (2020). Loneliness, mental health, and substance use among US young adults during COVID-19. *Journal of Psychoactive Drugs*, 53(1), 1–9. doi:10.1080/02791072.2020.1836435
- Iacobucci, D. (2010). Structural equations modeling: Fit indices, sample size, and advanced topics. *Journal of consumer psychology*, 20(1), 90–98
- JHU COVID-19 community response survey, module 10. (2020). Baltimore, MD: Johns Hopkins University, Bloomberg School of Public Health.
- Keyes, K. M., Hatzenbuehler, M. L., & Hasin, D. S. (2011). Stressful life experiences, alcohol consumption, and alcohol use disorders: The epidemiologic evidence for four main types of stressors. *Psychopharmacology*, 218(1), 1–17. doi:10.1007/s00213-011-2236-1
- Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford publications.
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9. *Journal of General Internal Medicine*, 16(9), 606–613. doi:10.1046/j.1525-1497.2001.016009606.x
- Law, B., Gullo, M. J., Daghli, M., Kavanagh, D. J., Feeney, G. F., Young, R. M., & Connor, J. P. (2016). Craving mediates stress in predicting lapse during alcohol dependence treatment. *Alcoholism: Clinical and Experimental Research*, 40(5), 1058–1064. doi:10.1111/acer.13034
- Little, R. J., & Rubin, D. B. (2019). *Statistical analysis with missing data* (Vol. 793). John Wiley & Sons.
- Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the generalized anxiety disorder screener (GAD-7) in the general population. *Medical Care*, 46(3), 266–274. doi:10.1097/mlr.0b013e318160d093
- Mallinckrodt, B., Abraham, W. T., Wei, M., & Russell, D. W. (2006). Advances in testing the statistical significance of mediation effects. *Journal of counseling psychology*, 53(3), 372.
- McGinniss, J., & Harel, O. (2016). Multiple imputation in three or more stages. *Journal of statistical planning and inference*, 176, 33–51.
- Mereish, E. H., & Miranda, R. (2019). Exposure to stigma elicits negative affect and alcohol craving among young adult sexual minority heavy drinkers. *Alcoholism: Clinical and Experimental Research*. doi:10.1111/acer.14055
- Morin, C. M., Belleville, G., Bélanger, L., & Ivers, H. (2011). The insomnia severity index: Psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep*, 34(5), 601–608. doi:10.1093/sleep/34.5.601
- National Institute on Alcohol Abuse and Alcoholism (NIAAA). (2020, February 18). *Alcohol facts and statistics*. Retrieved from <https://www.niaaa.nih.gov/publications/brochures-and-fact-sheets/alcohol-facts-and-statistics>
- Neupert, S. D., Desmarais, S. L., Gray, J. S., Cohn, A. M., Doherty, S., & Knight, K. (2017). Daily stressors as antecedents, correlates, and consequences of alcohol and drug use and cravings in community-based offenders. *Psychology of Addictive Behaviors*, 31(3), 315–325. doi:10.1037/adb0000276
- Rodriguez, L. M., Litt, D. M., & Stewart, S. H. (2020). Drinking to cope with the pandemic: The unique associations of COVID-19-related perceived threat and psychological distress to drinking behaviors in American men and women. *Addictive Behaviors*, 110, 106532. doi:10.1016/j.addbeh.2020.106532
- Schmidt, R. E., Harvey, A. G., & Van Der Linden, M. (2011). Cognitive and affective control in insomnia. *Frontiers in Psychology*, 2. doi:10.3389/fpsyg.2011.00349

- Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of educational research*, 99(6), 323–338.
- Schuchat, A. (2020). Public health response to the initiation and spread of pandemic COVID-19 in the United States, February 24–April 21, 2020. *The COVID-19 Reader*, 142–151. doi:10.4324/9781003141402-16
- Seo, D., Lacadie, C. M., Tuit, K., Hong, K., Constable, R. T., & Sinha, R. (2013). Disrupted Ventromedial prefrontal function, alcohol craving, and subsequent relapse risk. *JAMA Psychiatry*, 70(7), 727. doi:10.1001/jamapsychiatry.2013.762
- Sharma, P., Ebbert, J. O., Rosedahl, J. K., & Philpot, L. M. (2020). Changes in substance use among young adults during a respiratory disease pandemic. *SAGE Open Medicine*, 8, 205031212096532. doi:10.1177/2050312120965321
- Sherman, A. C., Williams, M. L., Amick, B. C., Hudson, T. J., & Messias, E. L. (2020). Mental health outcomes associated with the COVID-19 pandemic: Prevalence and risk factors in a southern US state. *Psychiatry Research*, 293, 113476. doi:10.1016/j.psychres.2020.113476
- Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychological methods*, 7(4), 422–430.
- Sinha, R., & Jastreboff, A. M. (2013). Stress as a common risk factor for obesity and addiction. *Biological Psychiatry*, 73(9), 827–835. doi:10.1016/j.biopsych.2013.01.032
- Smith, N., & Cottler, L. B. (2018). The epidemiology of post-traumatic stress disorder and alcohol use disorder. *Alcohol Research: Current Reviews*, 39(2), 113–120.
- Soltis, K. E., McDevitt-Murphy, M. E., & Murphy, J. G. (2017). Alcohol demand, future orientation, and craving mediate the relation between depressive and stress symptoms and alcohol problems. *Alcoholism: Clinical and Experimental Research*, 41(6), 1191–1200. doi:10.1111/acer.13395
- Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of Internal Medicine*, 166(10), 1092. doi:10.1001/archinte.166.10.1092
- Stanton, R., To, Q. G., Khalesi, S., Williams, S. L., Alley, S. J., Thwaite, T. L., . . . Vandelanotte, C. (2020). Depression, anxiety and stress during COVID-19: Associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. *International Journal of Environmental Research and Public Health*, 17(11), 4065. doi:10.3390/ijerph17114065
- The Nielsen Company. Rebalancing the ‘COVID-19 Effect’ on alcohol sales. <https://www.nielsen.com/us/en/insights/article/2020/rebalancing-the-covid-19-effect-on-alcohol-sales/> Published May 7, 2020. Accessed December 28, 2020
- Tidey, J. W., Monti, P. M., Rohsenow, D. J., Gwaltney, C. J., Miranda, R., Mcgeary, J. E., . . . Paty, J. A. (2007). Moderators of Naltrexone’s effects on drinking, urge, and alcohol effects in non-treatment-seeking heavy drinkers in the natural environment. *Alcoholism: Clinical and Experimental Research*, 32(1), 58–66. doi:10.1111/j.1530-0277.2007.00545.x
- U.S. Department of Health & Human Services. (2020, March 13). *Secretary Azar declares public health emergency for United States for 2019 novel coronavirus*. Retrieved from <https://www.hhs.gov/about/news/2020/01/31/secretary-azar-declares-public-health-emergency-us-2019-novel-coronavirus.html>
- Walker, D. A., & Smith, T. J. (2017). Computing robust, bootstrap-adjusted fit indices for use with nonnormal data. *Measurement and Evaluation in Counseling and Development*, 50(1-2), 131–137.
- West, S. G., Taylor, A. B., & Wu, W. (2012). Model fit and model selection in structural equation modeling. *Handbook of structural equation modeling*, 1, 209–231