


Is the COVID-19 Pandemic a High-Risk Period for College Student Alcohol Use? A Comparison of Three Spring Semesters

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Background: There has been widespread concern that the COVID-19 pandemic may be a high-risk time for alcohol use among heavy drinking populations such as college students. Initial efforts to evaluate changes in college drinking have not yet accounted for typical drinking patterns within a semester.

Methods: To fill this gap, we evaluated how college student drinking patterns changed with the onset of restrictions related to the COVID-19 pandemic during spring 2020 relative to spring 2018 and 2019. Participants were 1,365 college students aged 19 and older, including 895 students who reported past-month alcohol use. Daily drinking data were extracted from an online Timeline Followback survey.

Results: Negative binomial hurdle models revealed that, with the onset of the COVID-19 pandemic in spring 2020, college student drinkers did not increase their drinking frequency as was typical in late spring semester, and the number of drinks per occasion declined substantially (28% reduction), greater than the change observed from early to late spring 2018 (3% reduction) or spring 2019 (8% increase). This reduction in drinking quantity in spring 2020 was larger for college student drinkers who moved residences because of the pandemic (49% reduction) than students who did not move (21% reduction). Perceptions in pandemic-related changes in drinking also revealed that 83.5% of college student drinkers self-reported that their drinking stayed the same or decreased.

Conclusions: Findings suggest that, on average, college students drank less—not more—during the onset of the COVID-19 pandemic and highlight the importance of living situation in college student drinking behavior. More research is needed to assess alcohol use in other universities, as this information could be utilized in norms-based interventions to further reduce drinking in students who remain at risk.

Key Words: Coronavirus, COVID-19, Alcohol Use, University Students, Young Adults.

COLLEGE STUDENT DRINKING is a long-standing public health concern in the United States given that heavy drinking and associated negative consequences are typical in this population (White and Hingson, 2013). Nationally, the prevalence of college drinking has declined in recent years (e.g., past-month alcohol use decreased from 63% in 2015 to 60% in 2018; Schulenberg et al., 2019). However, within a given year, college student drinking fluctuates, and high-risk events for heavy drinking have been identified (e.g., spring break, 21st birthdays; Geisner et al., 2017; Lee et al., 2009). Identification of high-risk drinking events and common elements across such events is crucial to inform prevention and intervention efforts designed to reduce heavy

drinking and mitigate alcohol-related negative consequences in college students.

Recently, researchers have raised concerns that a pandemic may be a high-risk time for heightened alcohol use (Clay and Parker, 2020; McKay and Asmundson, 2020; Walker et al., 2020; Zaami et al., 2020). On March 11, 2020, the World Health Organization declared the 2019 novel coronavirus disease (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, to be a pandemic (Centers for Disease Control and Prevention [CDC], 2020). In the United States, a national emergency was announced 2 days later (CDC, 2020), and state and local guidance regarding social distancing soon followed. Broad societal changes affected each subset of the population, including college students. Mid-semester, many students were asked to move out of campus housing, experienced disruption in their classes, canceled nonessential travel plans (e.g., spring break trips), and learned that gatherings such as graduation were postponed or moved to an online format. In the United States, there were 20.5 million job losses in April 2020 (Bureau of Labor Statistics, 2020) and many students lost campus-based employment (Brown, 2020). As the pandemic spread, the likelihood of knowing someone affected also increased. By June 2020, 1 in 5 US adults knew someone who had tested positive for SARS-CoV-2 (Czeisler et al., 2020).

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Alongside the multitude of pandemic-related stressors, depression, anxiety, and loneliness increased among college students and young adults (Lee et al., 2020; Li et al., 2020). Concern was raised that, to cope with such distress, some individuals may have increased their drinking (Clay and Parker, 2020; McKay and Asmundson, 2020; Walker et al., 2020; Zaami et al., 2020), consistent with the self-medication hypothesis (Khantzian, 1985). Indeed, associations between distress and drinking to cope during the pandemic have been documented in adults in the community (Rodriguez et al., 2020; Wardell et al., 2020). Further, some individuals may have increased their drinking out of boredom while spending more time at home (Canadian Centre on Substance Use and Addiction [CCSA], 2020). On the other hand, the pandemic also involved closures of bars and cancelation of events where alcohol consumption typically takes place. Combined with the financial limitations brought on by unemployment, the pandemic may have also resulted in decreased alcohol consumption for some individuals (Maggs, 2020; Rehm et al., 2020).

Following this speculation, research began to emerge on alcohol use during the COVID-19 pandemic, with some initial studies focused on potential increases in consumption. For example, 32% of regular drinkers in China increased their drinking in March 2020 (Sun et al., 2020), and by June, 13% of US adults reported having started or increased substance use to cope with pandemic-related stressors (Czeisler et al., 2020). US sales of alcohol also increased in March (Micallef, 2020), but closures of bars and restaurants make individual alcohol sales difficult to interpret (Chodkiewicz et al., 2020). Other research evaluated both increases and decreases in alcohol use. Studies conducted in April and May with adults in the United States, Canada, Australia, and Poland revealed drinking remained relatively constant for most adults (55% to 77%), but decreased for some (12% to 27%) and increased for others (16% to 18%; Barbosa et al., 2020; CCSA, 2020; Sidor and Rzymiski, 2020; Stanton et al., 2020). In a study of US college students, a slightly different pattern emerged; drinking quantity decreased for 53%, stayed the same for 43%, and increased for only 4% of students (Graupensperger et al., 2020). Given this variability, it remains unclear whether the pandemic truly represents a high-risk period for alcohol use—especially for college students, a group typically at risk for heavy drinking.

Although this emerging literature sheds light on alcohol consumption during a pandemic, this work is limited in several respects. First, these studies often rely on single-item, retrospective, subjective assessments of drinking changes that participants attribute to COVID-19 (e.g., Barbosa et al., 2020; CCSA, 2020; Graupensperger et al., 2020; Sidor and Rzymiski, 2020; Stanton et al., 2020). Second, this work has been presented without consideration of drinking trends more broadly. If drinking increased substantially in 2020 relative to past years, this would run in contrast to recent yearly decreases in alcohol use rates (Schulenberg et al., 2019) and suggest changes may be specific to the pandemic. However,

research to date has focused on changes during the months that coincided with the beginning of the pandemic and is difficult to disentangle from typical month-to-month fluctuations during the academic year. For example, in studies of US college students, average alcohol use increased during 2 weeks of March 2020 (Lechner et al., 2020), and more problematic alcohol use was reported by students responding in April to May 2020 than fall 2019 (Charles et al., 2020). However, the high-risk drinking event of college spring break often takes place in late March, which makes it difficult to determine whether increased drinking during this time is typical for students or is specific to factors encountered during the COVID-19 pandemic.

Current Study

Building on recent work evaluating alcohol use trends during the COVID-19 pandemic, the overall goal of this study was to evaluate whether and why this pandemic might be a time of unique risk for college student drinking. Within the context of an ongoing study of college students that predated the onset of COVID-19, we had a natural opportunity to examine drinking behaviors before and after the onset of the pandemic. First, we examined how college student drinking patterns changed after the onset of the COVID-19 pandemic relative to other spring semesters over the last 3 years. Second, we explored pandemic-related experiences (cancelation of events, moved residences, social distancing, job loss, knew someone diagnosed with COVID-19) as moderators of change during spring 2020. Third, to facilitate comparisons with other samples, we examined student perceptions of changes in drinking during spring 2020 and evaluated differences by pandemic-related experiences. Given the prior mixed findings and overall preliminary state of this emerging literature, no hypotheses were made.

MATERIALS AND METHODS

Participants and Procedures

Undergraduate students at a large Midwestern US university were recruited from a psychology subject pool for a study about “life experiences” (Jaffe et al., 2021). The only inclusion criterion was age; individuals were required to be at least 19 years old (the local age of majority). Data were collected during the academic year between January 2018 and May 2020. Each semester, a new cohort of students was recruited, and 3 surveys (Waves 1–3) were administered with 1 month between each assessment (± 1 week). To promote inclusion and participation of students who seek research opportunities throughout the semester, students were allowed to enroll in the study and complete the baseline survey (Wave 1) at any time; eligibility for follow-up assessments (Waves 2 and 3) was based on time remaining in the semester. Specifically, participants who completed Wave 1 with at least 9 (of 16) weeks remaining in the semester were invited to complete Waves 2 and 3; those with 5–8 weeks remaining were only invited to complete Wave 2; those with less than 5 weeks remaining were not invited to either follow-up. At enrollment, participants provided informed consent for all study procedures and agreed to complete the follow-up surveys if eligible. Participants received research credit and students who completed all

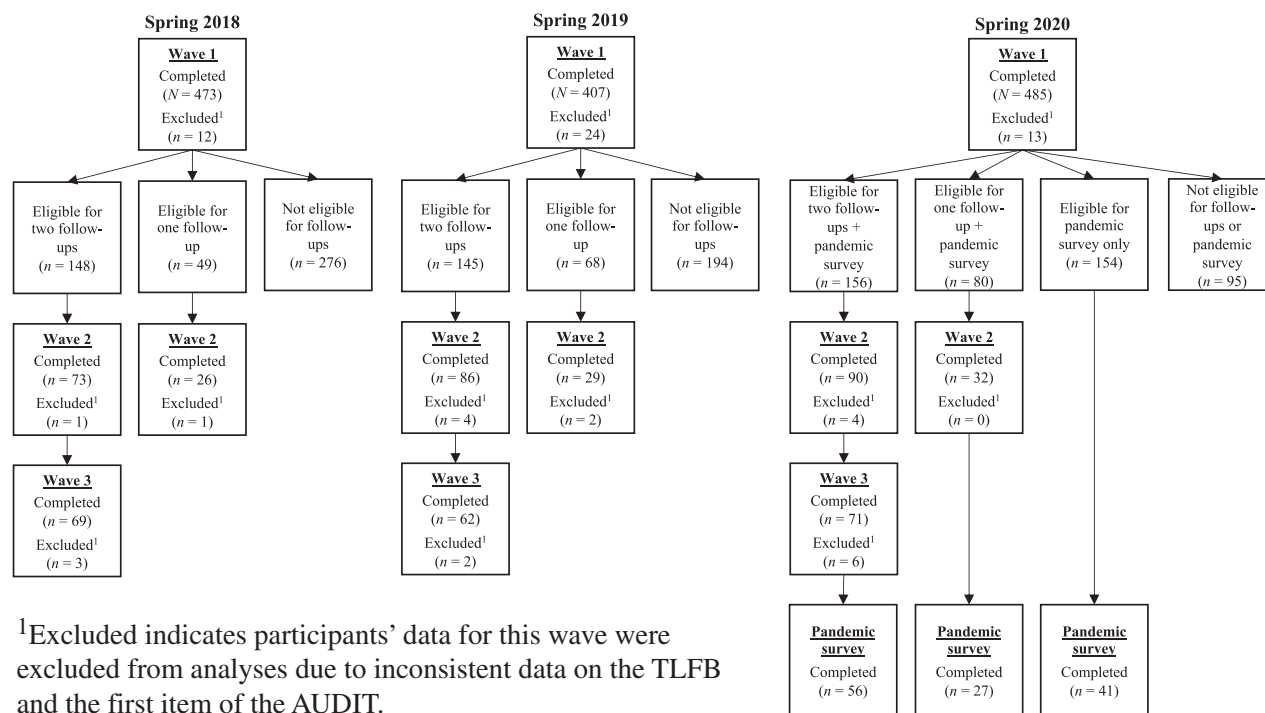


Fig. 1. Study flow chart.

surveys for which they were eligible were entered into a raffle for 1 of 2 tablet computers distributed each semester.

Local restrictions related to the COVID-19 pandemic were implemented on March 16, 2020 (the Monday before spring break began), including cancellation of classes, closing of restaurants, and issuance of state-wide guidance restricting public gatherings to 10 or fewer people. No official stay-at-home order was instituted in the state of data collection. Students at the current university were encouraged “to return, if possible, to your place of permanent residence” (Dunker, 2020), but were also allowed to stay on-campus. Approximately 80% of students moved out of this university’s residence halls during this time (Trujillo, 2020). To capture experiences during this time, participants who completed Wave 1 prior to the last week of the spring 2020 semester were invited to complete an additional online survey (“Pandemic Survey”) between April 24 and 29, 2020. Participants who completed the survey were entered into a separate raffle for an additional tablet computer. No additional research credit was awarded. The university’s Institutional Review Board approved all procedures.

Given this study’s focus on time-related trends, analyses focused on spring 2018, spring 2019, and spring 2020 for comparability. During these semesters, participants were 1,365 college students (68.5% female) with an average age of 20.32 ($SD = 2.45$). Most participants were non-Hispanic and White (73.3%) and heterosexual (91.9%). See Fig. 1 for the participant flow through the study.

Measures

Daily Alcohol Use. An online version of the Timeline Follow-back (TLFB; Pedersen et al., 2012) was used to assess drinks consumed for each of the previous 35 days.¹ Participants were encouraged to consult their personal calendar, consider events (e.g.,

anniversaries, birthdays), and recognize regular drinking patterns to aid in recalling their drinking. The TLFB is considered a reliable measure of alcohol use (e.g., Connors et al., 1985; Sobell et al., 1986), and the online version has demonstrated adequate test–retest reliability and convergent validity among college students (Miller et al., 2002; Pedersen et al., 2012).

In the current study, the number of drinks consumed on each date was extracted from the TLFB. Monthly assessments occasionally led to multiple reports for a given date; when this happened, the more recent report (i.e., involving less retrospective recall) was selected. Consistent with past work (e.g., Dworkin et al., 2020; Rodriguez et al., 2020), responses were capped at 25 drinks. Responses indicating a partial drink (e.g., 0.5) were rounded up, and blank responses were assumed to represent 0 drinks if the participant either (a) provided any responses to the TLFB or (b) indicated they “never” drank alcohol on the first question of the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993). Blank responses to the TLFB that could not be validated were considered missing.

Pandemic-Related Experiences. During the spring 2020 Pandemic Survey, changes in participants’ lives related to the COVID-19 pandemic were assessed. First, participants were asked to indicate the ways in which “the Coronavirus/COVID-19 pandemic affected your life thus far” by checking all that apply. Having *events canceled* was indicated by checking either “I had travel plans that were canceled” or “I had planned to attend a large event or celebration (e.g., graduation, wedding) that was canceled.” Participants were considered to have *moved* if they checked: “My place of residence changed (e.g., I moved off-campus).” Participants were considered to have had a *job loss* if they checked: “I lost a source of income (e.g., laid off or lost my job).”

To assess *social distancing*, participants were asked, “During the past 2 weeks, how would you describe the steps you’ve taken toward social distancing?”. Responses of “Living normal, I have not made any changes,” “Being cautious, but still going out,” or “Going out as needed, mostly staying home, still seeing friends and

¹Due to a survey error, Wave 1 of the spring 2020 semester was missing text boxes where participants could indicate drinks consumed for days 29 through 33. Data were considered missing for these days.

family,” were recoded as not substantially social distancing. Responses of “Very limited, only going out when unavoidable and very careful contact with people” and “Full lockdown, not going out at all” were recoded as social distancing.

Questions adapted from Nielson (2020) assessed diagnoses. Participants were asked, “Have you been suspected of having Coronavirus/COVID-19 infection?”. Responses of “Yes, have had positive test” and “Yes, medical diagnosis, but no test” were recoded as *personally received a diagnosis*, whereas responses of “Yes, have some possible symptoms, but no diagnosis by doctor” and “No symptoms or signs” were recoded as no personal diagnosis. Participants were considered to have *known someone diagnosed* if they responded “Yes” to “Do you know anyone personally who has tested positive for Coronavirus/COVID-19?” or indicated in a separate question that a partner or family member was “Hospitalized” or “Passed away” because of COVID-19. The coding for all pandemic-related experiences was standardized such that 0 = no and 1 = yes.

Perceived Changes in Drinking During COVID-19. During the spring 2020 Pandemic Survey, participants were also asked, “Since March 2020, when restrictions related to Coronavirus/COVID-19 began, how has your drinking changed?” (adapted from Graupensperger et al., 2020). Response options were as follows: “I drink much less alcohol,” “I drink somewhat less,” “No change in my drinking,” “I drink somewhat more,” and “I drink much more alcohol.”

Demographics. Participants self-reported their age in years and sex assigned at birth (coded 0 = female, 1 = male). Participants identified whether they were of Latinx/Hispanic/Spanish origin and selected all racial identities that apply from: American Indian / Alaska Native, Asian, Black / African American, Native Hawaiian / Other Pacific Islander, White, or other (recoded as 0 = non-Hispanic White or 1 = racial/ethnic minority). Participants also specified whether they considered themselves to be Heterosexual/Straight, Lesbian/Gay, Bisexual, something else, or unsure (recoded as heterosexual = 0, identification as sexual minority = 1).

Analytic Plan

Preliminary Analyses. Patterns of missingness were first evaluated regarding: (1) the likelihood of being eligible for a follow-up (an indicator of when the survey was completed), (2) the likelihood of completing all follow-up surveys for which one was eligible, and (3) the likelihood of completing the Pandemic Survey if eligible. Differences were evaluated by baseline demographics (age, birth sex, ethnic/racial identity, sexual orientation), as well as for proportion of days drinking and average drinks per drinking day at Wave 1 using t tests and chi-square tests of independence. To characterize the sample, alcohol consumption was examined descriptively.

Drinking Across the Years. To examine predictors of drinks consumed, generalized linear mixed models were estimated in R version 3.6.3 with *glmmTMB* (Brooks et al., 2017). Because nearly a third of participants (32.2%) reported no drinking on the TLFB, analyses were limited to drinkers (i.e., those who reported 1 or more drinking days on a Wave 1, 2, or 3 TLFB). Days (Level 1) were nested within participants (Level 2). Thus, predictors assessed within-persons were included at Level 1 and predictors assessed between-persons were included at Level 2, as specified below. Prior to estimating each multilevel model described below, we examined the degree of variability in drinking behavior attributable to between-person differences. To do so, intraclass correlation coefficients (ICCs) were computed by evaluating empty, random intercept only models with the *performance* package (Lüdtke et al., 2020).

Among drinkers, there were a large number of days with zero drinks and the distribution was positively skewed. To accommodate this zero-inflated count distribution, a hurdle model approach was employed, involving 2 submodels. First, a hurdle submodel was estimated using a logit link and binomial distribution to predict whether any drinks were consumed on a given day (i.e., drinking day). Second, a count submodel was estimated with a log-link and a zero-truncated negative binomial distribution to predict number of drinks consumed if any (i.e., drinks per drinking day). The same predictors were included in both submodels. Year was represented by 2 dummy variables (i.e., 2019 and 2020 in reference to 2018; Level 2). To evaluate whether drinking changed after the onset of COVID-19 restrictions (which occurred March 16, 2020, the Monday before spring break), or for comparable periods in prior semesters, a dummy variable represented Pre vs. Post restrictions (or comparable date) in all years (0 = Pre/before the Monday before spring break, 1 = Post/on or after the Monday before spring break; Level 1). To determine whether Pre–Post changes differed by year, a cross-level interaction (Year by Pre–Post) was included. Several time-related covariates were also included at Level 1. To facilitate examination of differences Pre vs. Post restrictions (or comparable date) above and beyond otherwise occurring trends in drinking over the course of the semester, we controlled for day in the semester (centered at the Monday before spring break; Level 1). To account for possible recall bias, we controlled for the number of days between survey completion and the day reported on within the TLFB (i.e., number of days retrospectively reporting²; Level 1). To account for variability in drinking behavior between weekdays and weekends, we also controlled for whether the day was a weekend (i.e., Thursday, Friday, or Saturday, consistent with Huh et al., 2015; Level 1). Demographics (age, birth sex, ethnic/racial identity) associated with follow-up eligibility and/or survey completion were included as Level 2 covariates in both submodels. Model estimates of the hurdle and count submodels were exponentiated and expressed as odds ratios (OR) and count ratios (CR; also known as incident rate ratios), respectively.

Pandemic-Related Experiences and Drinking in 2020. Second, to examine whether certain experiences during the pandemic were associated with different patterns of change in drinking, a second hurdle model was estimated. These analyses were limited to the 80 participants who reported drinking on the TLFB in spring 2020 and also completed the Pandemic Survey. The same time-related and demographic covariates were included as in the prior model; Pre–Post time was the predictor of interest. Main effects and interactions with Pre–Post time were examined for each of the following pandemic-related experiences: cancellation of events, moved residences, social distancing, job loss, and knowing someone who was diagnosed.

Perceived Drinking Changes in 2020. Finally, among the 124 participants who completed the Pandemic Survey, perceptions of changes in drinking were examined descriptively. To facilitate comparisons with recent research, categories were created to represent nondrinkers (indicated by no drinks reported on any TLFB), drinkers who reported decreased drinking, drinkers who reported increased drinking, and drinkers who reported no change in their drinking. Differences in drinking categories by pandemic-related experiences were evaluated using chi-square tests of independence and Fisher’s exact test (when cell sizes were below 5).

²As an example of the coding for retrospective reporting, for a participant who completed the survey on March 30, drinking behavior on the day prior (March 29) would be coded as 1 day of retrospective reporting; March 28 would be 2 days of retrospective reporting; March 27 would be 3 days of retrospective reporting, and so on.

RESULTS

Preliminary Analyses

Of the 1,365 participants, 646 were eligible for at least 1 follow-up survey, and 263 completed all follow-up surveys for which they were eligible (Fig. 1). Females were more likely than males to be eligible for follow-up (51.2% vs. 38.8%), $p < 0.001$, as well as complete all follow-up surveys (44.1% vs. 30.5%), $p = 0.003$. In addition, non-Hispanic White students were more likely to be eligible for follow-up than racial/ethnic minority students (50.7% vs. 38.1%), $p < 0.001$. Those who completed all eligible follow-ups were older at enrollment ($M = 20.49$, $SD = 2.68$) than those who did not complete all eligible follow-ups ($M = 20.06$, $SD = 2.29$), $p = 0.034$. There were no differences in eligibility or follow-up rates based on sexual orientation ($ps > 0.99$), proportion of days drinking ($ps > 0.11$), or average drinks per drinking day reported at Wave 1 ($ps > 0.10$).

Regarding drinking data, 1,320 students completed the TLFB in at least 1 Wave, and of those, 895 (67.8%) reported any drinking on the TLFB, with no significant difference between the years (68.4% in 2018, 71.2% in 2019, 64.5% in 2020), $p = 0.107$. Among drinkers, TLFB data were available for an average of 45.62 days ($SD = 21.35$; range: 30 to 105), of which drinking occurred on 7.55 days ($SD = 6.80$, range: 1 to 62), with an average of 3.81 drinks per drinking day ($SD = 2.13$, range: 1.00 to 14.50).

Regarding the Pandemic Survey, 124 (31.8%) of the 390 eligible students completed this survey, with greater completion for females (37.0%) than males (23.8%), $p = 0.009$, but no differences in age, ethnic/racial identity, or sexual orientation ($ps > 0.06$). Nearly a quarter of these students (23.4%; $n = 29$) knew someone who had tested positive for COVID-19. Of those, 5 students reported a loved one had been hospitalized and 3 reported a loved one had passed away due to COVID-19. Only 1 participant reported having personally received a medical diagnosis of COVID-19. Over a third of participants (36.3%; $n = 45$) had lost a job, about half were social distancing (48.0%, $n = 59$), and the majority had moved residences (58.9%; $n = 73$) or had events canceled (82.3%, $n = 102$).

Of these 124 participants who completed the Pandemic Survey, 123 previously completed the TLFB in at least 1 survey, 82 reported any drinking on the TLFB, and of those, 80 had complete data on the pandemic-related stressors. These 80 drinkers completed reports for an average of 58.51 days ($SD = 26.28$; range: 30 to 100), of which drinking occurred on 8.81 days ($SD = 8.22$, range: 1 to 33), with an average of 3.57 drinks per drinking day ($SD = 1.98$, range: 1.00 to 8.67).

Average Trends Over Time

Results of the model examining drinking across the years are presented in Table 1.

Table 1. Spring Semester Drinking Trends Across Years and Pre-Post COVID-19 Restrictions or Comparable Time

Predictor	Hurdle submodel: Drinking day		Count submodel: Drinks per drinking day	
	OR	p	CR	p
Age	1.05	0.014	0.97	0.003
Male (vs. Female)	1.46	<0.001	1.31	<0.001
Ethnic/racial minority (vs. non-Hispanic White)	0.73	0.003	0.88	0.028
Day in semester	0.99	<0.001	1.001	0.010
Days retrospective reporting	0.99	<0.001	0.997	0.003
Weekend	6.82	<0.001	1.16	<0.001
Post (vs. Pre)	1.26	0.006	0.97	0.416
Year: 2019 (vs. 2018)	0.93	0.512	0.96	0.446
Year: 2019 * Post	1.03	0.785	1.12	0.029
Year: 2020 (vs. 2018)	1.01	0.953	0.96	0.471
Year: 2020 * Post	0.81	0.061	0.75	<0.001

$N = 894$ college student drinkers (1 of the 895 college student drinkers was excluded from these models due to missing data on birth sex). Participants were included in analyses regardless of whether their drinking data were Pre, Post, or both Pre and Post. OR = odds ratio; CR = count ratio. Bolded p -values and corresponding estimates are statistically significant at $p < 0.05$.

Hurdle Submodel: Drinking Days. Among college student drinkers, the ICC revealed that 21.5% of the variability in drinking days was attributable to between-person differences. Results revealed that being older, male, and non-Hispanic White were each uniquely associated with a greater likelihood of drinking on a given day. Drinking days were also more likely on weekends and less likely for days with greater retrospective reporting. After controlling for all covariates, there was a main effect of Pre-Post time, such that drinking days were more likely in the latter part of the semester. However, this difference varied as a function of year, as illustrated in Fig. 2A. Although the interaction between Pre-Post time and the year of 2020 was only marginally significant ($p = 0.061$), pairwise comparisons revealed that the likelihood of drinking on a given day increased from Pre to Post in 2018 (OR = 1.26, 95% CI [1.07, 1.50], $p = 0.006$) and 2019 (OR = 1.30, 95% CI [1.10, 1.54], $p = 0.002$), but did not significantly change in 2020 (OR = 1.03, 95% CI [0.87, 1.22], $p = 0.752$).

Count Submodel: Drinks per Drinking Day. The ICC³ showed that 46.0% of the variability in drinks per drinking day was attributable to between-person differences. Being younger, male, and non-Hispanic White were associated with more drinks per drinking day. Regarding time-related covariates, days later in the semester and on the weekend were also associated with more drinks per drinking day.

³The ICCs for drinks per drinking day were computed assuming a normal distribution and should be interpreted with caution. Note that the calculation of ICC for variables with count distributions is in development (see Leckie et al., 2020) and appropriate calculations for zero-truncated negative binomial distributions are pending future research.

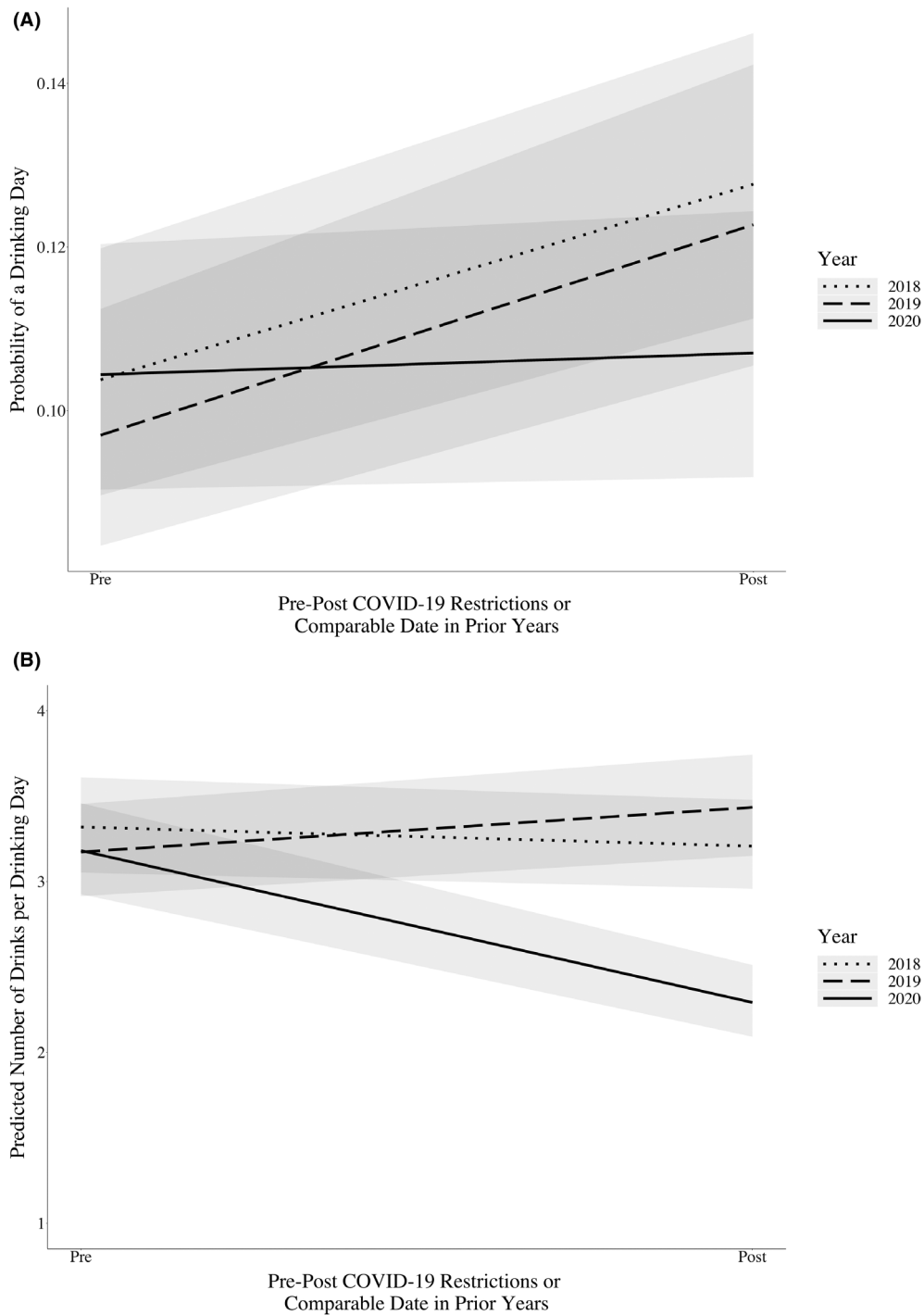


Fig. 2. (A) Model-predicted probability of drinking on a given day by year. (B) Model-predicted drinks per drinking day by year.

Additionally, greater retrospective reporting was associated with reporting fewer drinks per drinking day. Further, there were significant interactions between year and Pre–Post time (see Fig. 2B). Pairwise comparisons revealed that from Pre to Post, drinks per drinking day did not change in 2018 (CR = 0.97, 95% CI [0.89, 1.05], $p = 0.416$), increased slightly in 2019 (CR = 1.08, 95% CI [1.001, 1.170], $p = 0.046$), but decreased substantially in 2020 (CR = 0.72, 95% CI [0.66, 0.79], $p < 0.001$). That is, the proportion of

drinks consumed per drinking day decreased by 28% from Pre to Post pandemic-related restrictions in 2020.

Pandemic-Related Experiences and Drinking During Spring 2020

Results of the model examining drinking during spring 2020 as moderated by pandemic-related experiences are presented in Table 2.

Hurdle Submodel: Drinking Days. Among college student drinkers who completed the Pandemic Survey, the ICC revealed that 22.6% of the variability in drinking days was attributable to between-person differences. After controlling for demographic and time-related covariates, no pandemic-related experience was uniquely associated with drinking days across the semester or variability from Pre-to-Post pandemic-related restrictions.

Count Submodel: Drinks per Drinking Day. Within this same subsample, 30.2% of the variability in drinks per drinking day was attributable to between-person differences. After controlling for time-related and demographic covariates, having events canceled was associated with more drinks per drinking day across the semester. In addition, there was a significant interaction between Pre-Post time and moving. As shown in Fig. 3, when examined at average levels of demographic variables and other pandemic-related experiences within the sample, those who moved residences because of the pandemic reported greater decreases in drinks per drinking day (CR = 0.51, 95% CI [0.39, 0.67], $p < 0.001$) than students who did not move residences (CR = 0.79, 95% CI [0.64, 0.98], $p = 0.030$).

Perceived Drinking Changes During Spring 2020

Regarding perceptions of changes in drinking since restrictions related to COVID-19 began, the largest groups of drinking participants reported no change (43.0%) or

decreased drinking (40.5%), and few reported increased drinking (16.5%). There were no significant differences between perceived drinking changes in pandemic-related experiences (Table 3).

DISCUSSION

This study contributes to an emerging literature on substance use during the COVID-19 pandemic by placing college student drinking behaviors in the context of trends in recent spring semesters. Although national trends suggest slightly decreased college drinking rates in recent years (Schulenberg et al., 2019), past-month drinking at any point in the study was similar across 3 spring semesters (68.4%, 71.2%, 64.5% in 2018, 2019, 2020, respectively). Among college student drinkers, late spring semester during 2018 and 2019 was associated with increased drinking frequency (drinking days) but similar drinking quantity (drinks per drinking day). However, as the COVID-19 pandemic spread in spring 2020, drinking frequency did not increase as usual, and drinking quantity reduced substantially, with 28% fewer drinks per occasion than earlier in the semester. Perceptions in pandemic-related changes in drinking also revealed the overwhelming majority of college student drinkers self-reported their drinking stayed the same or decreased (83.5%), consistent with other recent research in college students (96% in Graupensperger et al., 2020).

To shed light on reasons underlying variability in change, we examined a number of pandemic-related experiences. The only experience that moderated drinking changes in spring 2020 was having moved residences, such that drinking quantity decreased more for college students who moved residences because of the pandemic (49% reduction) than students who did not move (21% reduction). Although there were no significant differences in perceived drinking changes by pandemic-related experiences, moving residences was reported in 75.0% of students who perceived a decrease in their drinking, relative to only 38.5% who perceived an increase in their drinking. Though data were not available on location of students' residences, 80% of students who had been living on-campus at the current university moved elsewhere and were encouraged to return to their permanent residence (e.g., parents' home; Dunker, 2020; Trujillo, 2020). Thus, findings appear to highlight the role of the college campus environment in perpetuating risk for heavy drinking and suggest moving off-campus or having greater parental monitoring may reduce heavy drinking in college students.

The current study also informs the interpretation of prior research involving retrospective self-report assessments of perceived changes in alcohol use during the COVID-19 pandemic. Encouragingly, the overall findings between the TLFB and the self-reported changes in drinking questions were largely consistent. Across both measures, findings showed that the prototypical participant reduced drinking during the pandemic and moving was the pandemic-related experience most associated with decreased drinking. This

Table 2. Pandemic-Related Experiences and Drinking Trends Within Spring 2020

Predictor	Hurdle submodel: Drinking day		Count submodel: Drinks per drinking day	
	OR	p	CR	p
Age	1.05	0.309	1.04	0.123
Male (vs. Female)	1.23	0.507	1.36	0.055
Ethnic/racial minority (vs. non-Hispanic White)	0.76	0.423	1.19	0.339
Day in semester	0.99	<0.001	1.00	0.364
Days retrospective reporting	0.98	0.001	0.99	0.013
Weekend	5.67	<0.001	1.38	<0.001
Post (vs. Pre)	1.39	0.382	1.49	0.150
Events canceled	1.64	0.229	2.11	0.002
Events canceled * Post	1.38	0.374	0.63	0.081
Moved	0.90	0.748	1.06	0.728
Moved * Post	0.73	0.213	0.65	0.008
Social distancing	0.61	0.090	0.91	0.547
Social distancing * Post	0.88	0.614	0.75	0.099
Job loss	1.42	0.260	1.22	0.210
Job loss * Post	0.75	0.253	0.86	0.290
Know someone diagnosed	1.26	0.541	0.84	0.420
Know someone diagnosed * Post	0.66	0.181	0.69	0.075

$N = 80$ college student drinkers. OR, odds ratio; CR, count ratio. Bolded p -values and corresponding estimates are statistically significant at $p < 0.05$.

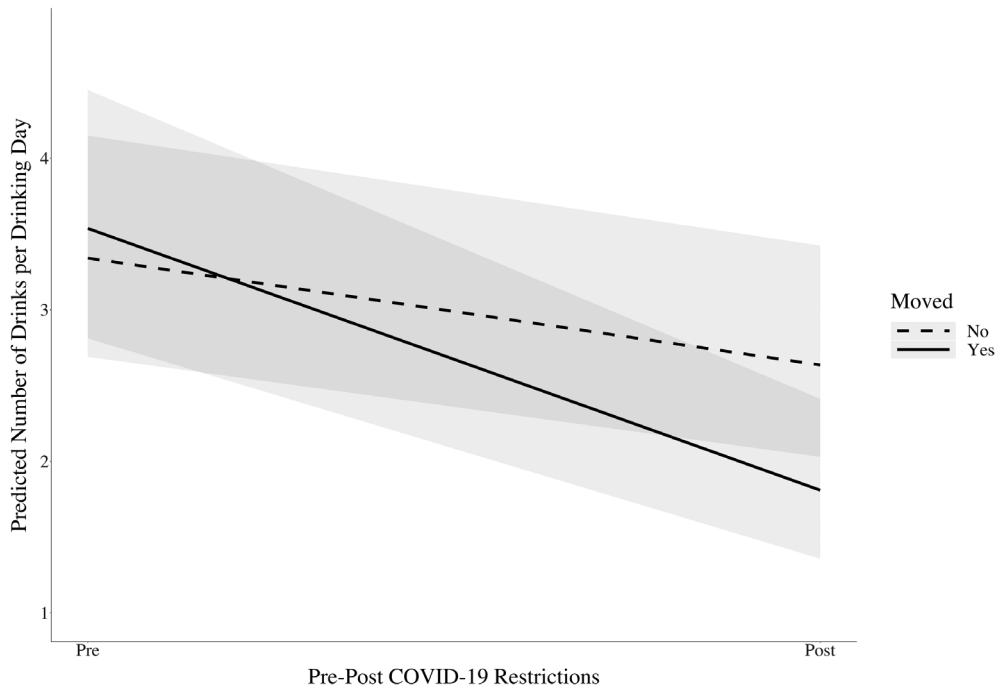


Fig. 3. Model-predicted drinks per drinking day in spring 2020 by moving residences.

Table 3. Frequency of Pandemic-Related Experiences and Perceived Drinking Changes

Variable	No drinking reported (n = 42)	Perceived decreased drinking (n = 32)	Perceived no change in drinking (n = 34)	Perceived increased drinking (n = 13)	p
Events canceled	33 (78.6%)	28 (87.5%)	28 (82.4%)	11 (84.6%)	0.820
Moved	26 (61.9%)	24 (75.0%)	16 (47.1%)	5 (38.5%)	0.051
Social distancing	20 (47.6%)	19 (59.4%)	15 (44.1%)	3 (23.1%)	0.173
Job loss	14 (35.7%)	12 (37.5%)	9 (26.5%)	8 (61.5%)	0.170
Know someone diagnosed	12 (28.6%)	9 (28.1%)	6 (17.6%)	2 (15.4%)	0.607

Three participants did not complete the item regarding perceived changes in drinking, resulting in N = 121. p-values reflect tests of differences, calculated via Fisher’s exact test (events canceled, social distancing, know someone diagnosed) or chi-square test of independence (moved, job loss).

consistency across overall findings suggests that self-reported perceptions of change may be valuable when more detailed assessments are not possible. However, examination of time-related covariates in the models predicting drinking behaviors on the TLFB also merits consideration. First, greater quantity of alcohol consumption was reported with more days (i.e., later) in the spring semester, regardless of year. This finding suggests that reports of increased drinking during specific weeks or months that coincided with the onset of the COVID-19 pandemic (e.g., Lechner et al., 2020) may not be due to the pandemic, but instead may be typical for trends observed during this time of year. Second, we observed that lower frequency and quantity of drinking were reported for days farther in the past, suggesting retrospective reporting may lead to underreports of alcohol consumption, consistent with past work (Gmel and Daepfen, 2007). This suggests that when individuals are asked to report on average drinking during separate periods (e.g., February and April 2020; Barbosa et al., 2020), drinking may be underreported for

pre-COVID-19 periods due to retrospective bias, and observed increases in drinking may be an artifact of the measurement. That is, if an individual’s actual drinking behaviors remained consistent from pre- to post-COVID-19, but pre-COVID-19 drinking was underreported due to retrospective bias, more recent post-COVID-19 drinking may look like an increase when it is not. Different patterns of retrospective bias have also been observed for different typical drinking behaviors and drinking events (e.g., Patrick and Lee, 2010) and merit consideration when interpreting retrospective research on pandemic-related changes in alcohol use.

Strengths and Limitations

Strengths of the current study included repeated assessments within a semester, multiple cohorts of students representing different semesters, the use of the TLFB to examine daily drinking data, and direct assessment of pandemic-

related experiences. However, the current study was conducted in the context of an ongoing research project and generalizability may be limited. Importantly, data were collected in a state where official stay-at-home orders were not issued. Although there was a ban on gatherings of 10 or more people in this state, the specific effect of a stay-at-home order could not be assessed. In addition, rates of COVID-19 cases and local norms regarding social distancing varied greatly across the United States, and thus, findings may be specific to the current university. For example, 23.4% of the current sample knew someone who was diagnosed with COVID-19, which was consistent with US adults broadly at that time (20.3%; Czeisler et al., 2020), but lower than rates observed in students in a southern US university (41.3%; Charles et al., 2020). Moreover, the majority of the current sample and broader university population were non-Hispanic White, and increased substance use during the pandemic has been more common among Hispanic and Black adults (Czeisler et al., 2020). Thus, the current university may not be representative of other college settings. Still, perceived changes in drinking were largely consistent with a study of US college students in the Pacific Northwest (Graupensperger et al., 2020), suggesting some convergence in findings across institutions and states. Finally, there was a large degree of attrition in the current study, and although we examined predictors of attrition, survey completion may have been influenced by unobserved factors that may reduce generalizability of drinking trajectories observed here. The Pandemic Survey had a particularly low response rate given that it was administered at the end of the semester during a pandemic. Thus, findings regarding pandemic-related experiences may not represent all students' experiences, even at the current university.

CONCLUSIONS

Despite broad concern that the COVID-19 pandemic may be a high-risk time for heightened alcohol use—including among the typically heavy drinking population of college students—current findings suggest alcohol use decreased among most college students since pandemic-related restrictions began. Specifically, participants at a Midwestern US university reduced the amount of alcohol they consumed during each drinking episode early in the COVID-19 pandemic, particularly if they moved residences at the time. These findings run in contrast to broad concerns about increased alcohol use during the pandemic and early findings in the broader US adult population (e.g., Barbosa et al., 2020). To reconcile these differences and determine the generalizability of current findings, we encourage epidemiological research on alcohol use during the pandemic, as well as evaluation of student status and change in living environments as moderators of pandemic-related alcohol use changes. If current findings are replicated, it may be beneficial to increase awareness that the average college student's drinking has decreased during the pandemic. The use of such information within personalized normative feedback

interventions (see Dotson et al., 2015) or public health campaigns may help to further reduce drinking among at-risk college students.

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REFERENCES

- Barbosa C, Cowell A, Dowd W (2020, July) How has drinking behavior changed during the COVID-19 pandemic?. Results from a nationally representative survey. RTI International. https://www.rti.org/sites/default/files/covid19_alcohol_survey_webinar_slides_071420.pdf.
- Brooks ME, Kristensen K, van Benthem KJ, Magnusson A, Berg CW, Nielsen A, Skaug HJ, Machler M, Bolker BM (2017) glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling. *The R Journal* 9(2):378–400.
- Brown S (2020) March 25) When Covid-19 closed colleges, many students lost jobs they needed. Now campuses scramble to support them. *The Chronicle of Higher Education*. <https://www.chronicle.com/article/when-covid-19-closed-colleges-many-students-lost-jobs-they-needed-now-campuses-scramble-to-support-them/>.
- Bureau of Labor Statistics (2020, May 8) The employment situation – April 2020. US Department of Labor. https://www.bls.gov/news.release/archives/empisit_05082020.pdf
- Canadian Centre on Substance Use and Addiction. (2020) 25% of Canadians (aged 35-54) are drinking more while at home due to COVID-19 pandemic; cite lack of regular schedule, stress and boredom as main factors. <https://www.ccsa.ca/sites/default/files/2020-04/CCSA-NANOS-Alcohol-Consumption-During-COVID-19-Report-2020-en.pdf>
- Centers for Disease Control and Prevention. (2020) New ICD-10-CM code for the 2019 Novel Coronavirus (COVID-19). <https://www.cdc.gov/nchs/data/icd/Announcement-New-ICD-code-for-coronavirus-3-18-2020.pdf>
- Charles NE, Strong SJ, Burns LC, Bullerjahn MR, Serafine KM (2020) Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. *PsyArXiv Preprints*. <https://psyarxiv.com/rge9k>.
- Chodkiewicz J, Talarowska M, Miniszewska J, Nawrocka N, Bilinski P (2020) Alcohol consumption reported during the COVID-19 pandemic: The initial stage. *Int J Env Res Pub He* 17(13):4677.
- Clay JM, Parker MO (2020) Alcohol use and misuse during the COVID-19 pandemic: a potential public health crisis? *Lancet Pub He* 5(5):e259.
- Connors GJ, Watson DW, Maisto SA (1985) Influence of subject and interviewer characteristics on the reliability of young adults' self-reports of drinking. *J Psychopathol Behav* 7:365–374.
- Czeisler ME, Lane RI, Petrosky E, Wiley JF, Christensen A, Njai R, Weaver MD, Robbins R, Facer-Childs ER, Barger LK, Czeisler CA, Howard ME (2020) Rajaratnam SMW (2020) Mental health, substance use, and suicidal ideation during the COVID-19 pandemic—United States, June 24–30. Centers for Disease Control and Prevention: *Morbidity and Mortality Weekly Report* 69(32):1049–1057.
- Dotson KB, Dunn ME, Bowers CA (2015) Stand-alone personalized normative feedback for college student drinkers: a meta-analytic review, 2004 to 2014. *PLoS One* 10(10):e0139518.
- Dunker C (2020, March 16) UNL to refund room, board for students who leave dorms. *Journal Star*. <https://journalstar.com/lifestyles/health-med>

- fit/health/unl-to-refund-room-board-for-students-who-leave-dorms/article_f3de8d6a-8261-562d-aa62-bf27bec20b38.html.
- Dworkin ER, Jaffe AE, Fitzpatrick S, Rhew IC, Kaysen D (2020) Daily relationships between posttraumatic stress symptoms, drinking motives, and alcohol consumption in trauma-exposed sexual minority women. *Psychol Addict Behav*, Advanced online publication.
- Geisner IM, Rhew IC, Ramirez JJ, Lewis ME, Larimer ME, Lee CM (2017) Not all drinking events are the same: exploring 21st birthday and typical alcohol expectancies as a risk factor for high-risk drinking alcohol problems. *Addict Behav* 70:97–101.
- Gmel G, Daeppen JB (2007) Recall bias for seven-day recall measurement of alcohol consumption among emergency department patients: Implications for case-crossover designs. *J Stud Alcohol Drugs* 68:303–310.
- Graupensperger S, Jaffe AE, Hultgren BA, Rhew IC, Lee CM, Larimer ME (2020) The dynamic nature of injunctive drinking norms and within-person associations with college student alcohol use. *Psychol Addict Behav*, Advanced online publication.
- Huh D, Kaysen DL, Atkins DC (2015) Modeling cyclical patterns in daily college drinking data with many zeroes. *Multivar Behav Res* 50:184–196.
- Jaffe AE, Cero I, DiLillo D (2021) The #MeToo movement and perceptions of sexual assault: College students' recognition of sexual assault experiences over time. *Psychol Viol*, Advanced online publication.
- Khantzian EJ (1985) The self-medication hypothesis of addictive disorders: Focus on heroin and cocaine dependence. *Am J Psychiat* 142:1259–1264.
- Lechner WV, Lauren KR, Patel S, Grega C, Kenne DR (2020) Changes in alcohol use as a function of psychological distress and social support following COVID-19 related University closings. *Addict Behav* 110:106527.
- Leckie G, Browne W, Goldstein H, Merlo J, Austin P. (2020, February 13). Variance partitioning in multilevel models for count data. arXiv preprint arXiv:1911.06888.
- Lee CM, Cadigan JM, Rhew IC (2020) Increases in loneliness among young adults during the COVID-19 pandemic and association with increases in mental health problems. *J Adolescent Health* 67:714–717.
- Lee CM, Lewis MA, Neighbors C (2009) Preliminary examination of spring break alcohol use and related consequences. *Psychol Addict Behav* 23:689–694.
- Li HY, Cao H, Leung DY, Mak YW (2020) The psychological impacts of a COVID-19 outbreak on college students in China: a longitudinal study. *Int J Env Res Pub He* 17:3933.
- Lüdecke D, Makowski D, Waggoner P, Patil I (2020) performance: Assessment of regression models performance. R package version 0.4.6. <https://CRAN.R-project.org/package=performance>.
- Maggs JL (2020) Adolescent life in the early days of the pandemic: less and more substance use. *J Adolescent Health* 67:307–308.
- McKay D, Asmundson GJ (2020) COVID-19 stress and substance use: Current issues and future preparations. *J Anxiety Disord* 74:102274.
- Micallef J (2020) How the COVID-19 pandemic is upending the alcoholic beverage industry. *Forbes* <https://www.forbes.com/sites/joemicallef/2020/04/04/how-the-covid-19-pandemic-is-upending-the-alcoholic-beverage-industry/>.
- Miller ET, Neal DJ, Roberts LJ, Baer JS, Cressler SO, Metrik J, Marlatt GA (2002) Test-retest reliability of alcohol measures: Is there a difference between internet-based assessment and traditional methods? *Psychol Addict Behav* 16:56–63.
- Nielson D. (2020) The CoRonavIruS Health Impact Survey (CRISIS). V0.1. <https://github.com/nimh-compmpsyh/CRISIS>
- Patrick ME, Lee CM (2010) Comparing numbers of drinks: college students' reports from retrospective summary, followback, and prospective daily diary measures. *J Stud Alcohol Drugs* 71:554–561.
- Pedersen ER, Grow J, Duncan S, Neighbors C, Larimer ME (2012) Concurrent validity of an online version of the Timeline Followback assessment. *Psychol Addict Behav* 26:672–677.
- Rehm J, Kilian C, Ferreira BC, Jernigan D, Monteiro M, Parry CDH, Sanchez ZM, Mantney J, Ferreira-Borges C (2020) Alcohol use in times of the COVID 19: implications for monitoring and policy. *Drug Alcohol Rev* 39:301–304.
- Rodríguez LM, Litt DM, Stewart SH (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. *Addict Behav* 110:106532.
- Saunders JB, Aasland OG, Babor TF, De la Fuente JR, Grant M (1993) Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction* 88:791–804.
- Schulenberg JE, Johnston LD, O'Malley PM, Bachman JG, Miech RA, Patrick ME. (2019) Monitoring the future national survey results on drug use, 1975-2018: Volume II, college students and adults ages 19-60. Ann Arbor: Institute for Social Research, The University of Michigan.
- Sidor A, Rzymiski P (2020) Dietary choices and habits during COVID-19 lockdown: Experience from Poland. *Nutrients* 12(6):1657.
- Sobell MB, Sobell LC, Klajner F, Pavan D, Basian E (1986) The reliability of a timeline method for assessing normal drinker college students' recent drinking history: utility for alcohol research. *Addict Behav* 11:149–161.
- Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, Fenning AS, Vandelanotte C (2020) Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. *Int J Env Res Pub He* 17(11):4065.
- Sun Y, Li Y, Bao Y, Meng S, Sun Y, Schumann G, Kosten T, Strang J, Lu L, Shi J (2020) Brief report: increased addictive internet and substance use behavior during the COVID-19 pandemic in China. *Am J Addiction* 29:268–270.
- Trujillo T. (2020, March 17) UNL housing to stay open amid coronavirus outbreak, some move out. KLKN-TV. <https://www.klknv.com/unl-housing-to-stay-open-amid-coronavirus-outbreak-some-move-out/>
- Walker DA, Jaffe AE, Pierce AR, Walton TO, Kaysen DL (2020) Discussing substance use with clients during the COVID-19 pandemic: a motivational interviewing approach. *Psychol Trauma-US* 12(S1):S115–S117.
- Wardell JD, Kempe T, Rapinda KK, Single A, Bilevicius E, Frohlich JR, Hendershot CS, Keough MT (2020) Drinking to cope during COVID-19 pandemic: The role of external and internal factors in coping motive pathways to alcohol use, solitary drinking, and alcohol problems. *Alcohol Clin Exp Res*, 44 (10), 2073–2083.
- White A, Hingson R (2013) The burden of alcohol use: excessive alcohol consumption and related consequences among college students. *Alcohol Res-Curr Rev* 35(2):201–218.
- Zaami S, Marinelli E, Vari MR (2020) New trends of substance abuse during COVID-19 pandemic: an international perspective. *Front Psychiatry* 11:700.