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Exploring the Connections Between Craving, Depression, Sleep & Alcohol Use in Emerging Adults

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EXPLORING THE CONNECTIONS BETWEEN CRAVING, DEPRESSION, SLEEP, AND ALCOHOL USE IN EMERGING ADULTS

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ABSTRACT

EXPLORING THE CONNECTIONS BETWEEN CRAVING, DEPRESSION, SLEEP, AND ALCOHOL USE IN EMERGING ADULTS

Alcohol use among emerging adults is a public health concern as it has been associated with negative consequences, such as accidental injury (Hingson et al., 2009). Given the negative consequences experienced for emerging adults, there is a need to identify factors contributing to alcohol use to determine ways to reduce these consequences. Poor sleep has been associated with higher alcohol-related consequences (Miller et al., 2016), and alcohol use has been associated with poor sleep (Goodhines, Gellis, Kim, et al., 2019), however there may be other factors contributing to this relationship, such as alcohol craving and depression. Higher alcohol craving has been associated with poor sleep (Chakravorty et al., 2010). Moreover, depression was linked to poor sleep and drinking to alleviate negative mood states (Barahona-Correa et al., 2018). However, there is little research examining how depression and alcohol craving influence poor sleep quality and alcohol use among emerging adults.

The primary objective of this study was to determine how poor sleep quality, depression, and alcohol craving contribute to alcohol use. The specific aims of the study were to 1) elucidate the relationship between poor sleep quality, alcohol use, depression, and alcohol craving within emerging adults, 2) explore if depression moderates the relationship between poor sleep quality and alcohol use, 3) examine whether craving mediates the relationship of poor sleep quality and alcohol use, and 4) determine if this connection is stronger for those with depression. Participants were 373 emerging adults (56.6% White; 54.2% Male) from the United States with an average age of 24.63. Results indicated there were no associations between poor sleep quality and alcohol use or depression and alcohol use, but there were significant associations between poor sleep quality, depression, and alcohol craving. Depression did not moderate the relationship between

poor sleep quality and alcohol use. Alcohol craving mediated the relationship between poor sleep quality and alcohol use. Last, depression did not moderate the indirect association of poor sleep quality and alcohol use through alcohol craving. Future research should examine if targeting poor sleep quality and alcohol craving in an intervention would reduce alcohol use and consequences.

Keywords: [alcohol use, alcohol craving, sleep quality, depression, emerging adults]

I dedicate this thesis to my parents, Angela and Joe Moskal, my supportive close friends, and to all women in STEM looking to make a difference.

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Introduction

Emerging adults (18-29) have the highest rates of heavy alcohol use (Johnston et al., 2020). Specifically, 1 in 4 college-aged individuals report academic consequences from drinking, including performing poorly on exams, being behind on class material, and overall lower grades (NIAAA, 2021), as well as accidental injury and sexual violence (Hingson et al., 2009). A recent study by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) reported that 27% of people 18 and over have engaged in heavy episodic drinking within the past month, which has been described as five or more drinks for men and four or more drinks for women (NIAAA, 2021). Among 18–24-year olds, alcohol use is a leading contributor to injuries, which have been identified as the leading cause of death in this age group (Hingson et al., 2009). Thus, there is a need to reduce these consequences and determine underlying factors that contribute to hazardous alcohol use within this population.

Over the years, researchers have identified a multitude of risk factors for heavy drinking among college students. One individual-level variable that has related to drinking levels among college students is sleep quality and quantity. Previous research has suggested that lower levels of weekday sleep were associated with an increased likelihood of alcohol use (Pasch et al., 2012), and that an increase in alcohol use is linked to inadequate sleep (Miller et al., 2016). Another variable connected to sleep and alcohol use is depression. Previous research has linked poor mental health with poor sleep, which indirectly led to alcohol use in college students (Kenney et al., 2013). Although poor sleep has been connected to drinking levels, and depression contributes to both poor sleep and alcohol-related consequences, the precise mechanisms that may link these factors remain unclear. Alcohol craving represents a potential mediating variable of the relationships between sleep and alcohol use (Bresin & Verona, 2021), while depression

represents a potential moderating variable. Given past research linking sleep quality, alcohol craving, and depression to alcohol use independently, the present study aims to investigate how these variables interact to influence heavy alcohol use among emerging adults. These variables may serve as important prevention and intervention targets that may lead to reductions in heavy drinking and alcohol-related consequences.

Associations between Depression and Alcohol Use

Major Depressive Disorder (MDD) and Alcohol Use Disorder (AUD) are prevalent in young adult populations and are often comorbid (Brière et al., 2014). According to Mistler and colleagues (2012), 36% of college students experience depression, and those who experience alcohol-related consequences frequently report experiencing depression and anxiety (Rush et al., 2008). Multiple studies have shown a link between depression and alcohol-related consequences (Camatta and Nagoshi, 1995). Compared to individuals without symptoms of depression, individuals with depression exhibit greater alcohol-related consequences (Weitzman, 2004). Boden and Fergusson (2011) investigated the causal relationship of major depressive disorder (MDD) and alcohol use disorder (AUD) and found AUD increases the risk for MDD, such that the more drinks a person consumes, the greater their risk for developing depression. Therefore, because 36% of college-aged individuals experience depression, and alcohol use is a risk for developing depression, it is imperative to include depression when evaluating factors associated with alcohol use within the emerging adult population.

Associations between Depression, Sleep, and Alcohol Use

Chronic insomnia is a risk factor for MDD and substance use disorder (SUD; Lund et al., 2010). There is a well-established relationship between depression and sleep, such that individuals with symptoms of depression often report disruptions to sleep that include longer

sleep latency, more frequent and longer awakenings, irregular REM sleep, poor sleep quality and shorter sleep time compared to those without depression symptoms (Gillin and Wallace, 1979; Reynolds, 1987; Rezaei et al., 2018). Using EEG data, Gillin and Wallace (1979) demonstrated that patients with depression have shorter REM latency. Moreover, previous research has shown that among medical students at the preclinical level, higher prevalence of psychological distress was observed among those with poor sleep quality (Rezaei et al., 2018). Similarly, in a sample of college students, those who reported poor sleep quality also had significantly greater negative mood (Lund et al., 2010). This suggests that symptoms of depression are associated with poor sleep among a wide range of individuals, but college students may be especially likely to experience both poor sleep and depression symptoms. Further, Mayers and colleagues (2009) demonstrated that individuals who report depression symptoms also report lower sleep satisfaction, while Brooks and colleagues (2009) found that less than average amounts of sleep were associated with greater depressive symptoms two weeks later. This suggests a bidirectional relationship between depression and sleep. Thus, depression can cause sleep disturbances and sleep disturbances can lead to depression symptoms.

Both depression symptoms and poor sleep have been shown to be associated with alcohol use. In a sample of medical students, Barahona-Correa and colleagues (2018) found that poor sleep was associated with substance use and depressive symptoms. Further, Kenney and colleagues (2013) used a path analytic model to investigate the direct and indirect associations of mental health, sleep, and alcohol use and related consequences among a large sample of undergraduate students from two West Coast universities. This study found that poor mental health was directly associated with alcohol-related consequences, while poor mental health was only linked to alcohol use through poor sleep quality. This suggests that poor sleep quality may

be an underlying factor contributing to the relationship of poor mental health and alcohol use in undergraduate students.

Associations between Sleep and Alcohol Use

Sleep problems are commonly associated with alcohol use, and previous research has linked alcohol use with insufficient sleep (Kwon et al., 2020; Pasch et al., 2012). Sleep disturbances have also been reported in 90% of individuals with alcohol use disorder (Cohn et al., 2003). Notably, alcohol is commonly used as a sleep-aid for initiating sleep among college students and adults (Goodhines, Gellis, Kim, et al., 2019; Stein & Friedmann, 2005). Although lower doses of alcohol at night are associated with increased sleep time, higher doses may lead to extreme sleep-disruption (Stein & Friedmann, 2005). It is clear that alcohol can exacerbate sleep disturbances and that poor sleep can incite alcohol use.

Previous research has demonstrated associations between sleep, alcohol use, and alcohol-related consequences among adolescents and emerging adults. In a sample of college students, Miller and colleagues (2016) found that heavy-drinking individuals who endorsed higher drinks per week reported more alcohol-related consequences, and this effect was stronger in those who reported inadequate sleep. In a follow-up study, Miller and colleagues (2017) investigated whether poor sleep health predicted the onset of substance use among adolescents and found that short sleep duration and daytime sleepiness were unique prospective predictors of alcohol use and related consequences. As such, for every hour of additional sleep, this reduced the probability of having one full drink by about 15%. The results suggest that increasing sleep may reduce the initiation of heavy alcohol use. Killgore and colleagues (2006) demonstrated that sleep deprivation was linked to more risky decision making. Moreover, Wong and Brower (2012) found that fewer hours of sleep were associated with greater odds of alcohol-related

interpersonal consequences over an 8-year span. It is possible that increasing hours of sleep may serve as a protective factor when individuals are drinking, leading to less risky decision making and less alcohol-related consequences. As reviewed above, multiple studies have suggested that lower sleep quality or less hours of sleep have contributed to alcohol use and/or alcohol-related consequences. This suggests that improving sleep may lead to better decision making, reductions in alcohol use, and alcohol-related consequences.

Overall, the literature has shown bidirectional relationships between alcohol use and sleep. Emerging adults engaging in alcohol use prior to sleep are at risk for risky substance-related behaviors, and in turn poor sleep could be affecting their alcohol use. There are factors unique to the college environment that may lead to poor sleep, such as minimal adult supervision, erratic schedules, and easy access to over-the-counter prescriptions (Lund et al., 2010). Lund and colleagues (2010) investigated the extent of sleep deprivation and poor-quality sleep in college students and found that 25% reported less than 6.5 hours of sleep at night. Individuals who reported poor-quality sleep also reported drinking more alcohol than those who reported optimal sleep and were twice as likely to drink alcohol to induce sleep. Additionally, 20% reported staying up all night at least once in the past month. Therefore, more research on sleep and alcohol use in the emerging adult population is warranted.

Thus far, most research on sleep and alcohol use has focused on the associations between these two variables and has demonstrated bidirectional associations. However, it remains unclear exactly how sleep and alcohol use influence one another. Mechanisms underlying these relationships must be explored to better understand the link between sleep and alcohol use. One potential mechanism underlying the connection between sleep and alcohol use is alcohol craving.

Associations between Craving and Alcohol Use

Craving for alcohol can be defined as a strong urge or desire to drink. Frequent and intense craving has been associated with alcohol use among young adults (Kavanagh & Connor, 2013; Rosenberg & Mazzola, 2007). The two main forms of craving are momentary and background craving. Momentary craving consists of craving in the moment as a response to emotional stimuli or drug relapse (Ferguson & Shiffman, 2009), while background craving exists regardless of situational cues in the real world and the laboratory (Dunbar et al., 2014). With momentary craving, this could be triggered by environmental cues or internal states to initiate drinking (Trela et al., 2018). While with background craving, previous research has stated background craving occurs over a span of a few days or weeks and is assessed during clinical trials (Ferguson & Shiffman, 2009). In sum, previous research has shown a few ways in which drinking is manifested through momentary craving and through background craving.

Momentary-craving is incited when individuals are presented with a substance-specific cue or a person-specific cue. A substance-specific cue is a stimulus commonly associated with substance use such as bottles or prescriptions, whereas a person-specific cue is unique to the person's environment or a common social-context (Fatseas et al., 2015). Previous research has demonstrated when an individual experiences person-specific cues or substance-specific cues, later substance use is mediated by craving, individuals who report more alcohol-related consequences also experienced more craving, and in individuals who reported higher craving levels this predicted greater volumes of alcohol consumption (Fatseas et al., 2015; Ramirez & Miranda, 2014). Because momentary-craving has been found to be proximal to consumption, craving seems to be a critical variable to alcohol use.

Regarding background-craving, there are a few studies that investigated overall craving level with alcohol use. McHugh and colleagues (2016) used a sample of individuals who sought

treatment for alcohol-dependence and completed self-report measures of craving and alcohol use. The results showed that craving was significantly associated with heavy drinking in the following week, and individuals with higher craving levels had an increased likelihood of drinking alcohol in the next two weeks. However, beyond two weeks, there was no association between craving and drinking. This suggests that craving is an imminent risk for drinking and a predictor of drinking initiation. Similarly, Flaudias and colleagues (2019) explored the interactions of craving and impulsivity on alcohol consumption in college students. The data suggested that individuals with higher craving scores reported increased alcohol consumption. Overall, these studies demonstrate that craving can also be measured at the background level and that higher craving has been associated with an increase in alcohol use.

In sum, alcohol craving can be elicited in many situations, whether it be momentary or background. There may be other factors that incite craving or increase an individual's level of craving. For example, both sleep quality and depression may impact an individual's level of alcohol craving.

Associations of Depression and Alcohol Craving

The relationship between negative affect and craving has been examined for many years. Negative affect is a cue for craving in both laboratory and clinical settings (Sinha & O'Malley, 1999), such that experiencing negative affect and attempting to eliminate negative affect have been identified as motives to use a substance. Regarding depression and craving, it has been found that individuals who experience depression exhibit a strong link between their depressive symptoms and levels of craving (Gordon et al., 2006). Moreover, Witkiewitz and Bowen (2010) found that craving mediated the relation between post-intervention depressive symptoms and days of alcohol use. Previous research has shown that as depressive symptoms decrease, so does

alcohol craving. In turn, in a sample of individuals going through a withdrawal and detoxification program, a decrease in depression was followed by a decrease in craving (Timary et al., 2013). Thus, it has been shown that depression and craving are positively correlated, such that an increase in depressive symptoms is associated with an increase in alcohol craving.

Associations between Sleep and Alcohol Craving

While previous studies have shown that sleep and craving individually impact alcohol use, there has been limited research looking at the interaction of these variables. Regarding sleep and alcohol craving, previous research has shown an inverse association between alcohol craving and sleep quality. Freeman and Gottfredson (2018) demonstrated that cumulative sleep quality is predictive of alcohol craving, suggesting that sleep dysfunction is strongly related to persistent craving experiences. Similarly, Chakravorty and colleagues (2010) examined the relations between alcohol craving and several variables, including sleep disturbance. Their results demonstrated that actively drinking participants reported greater sleep complaints and sleep problems were positively associated with craving, such that individuals with more sleep problems reported higher levels of craving. More recently, Graupensperger and colleagues (2022) examined daily associations between alcohol craving and sleep quality in a young adult population. Their results demonstrated that young adults elicited stronger alcohol craving following a day of low sleep duration and that alcohol use and craving were both higher during a period of sleep deficits. A similar relationship has been found when examining the impact of sleep quality on craving for opioids, where individuals with higher craving reported lower sleep quality and individuals with higher sleep quality had lower craving levels (Lydon-Staley et al., 2017; Teeters et al., 2020). Because alcohol is the most commonly used substance among

emerging adults it is imperative to determine if poor sleep in this population is linked to greater alcohol craving, which could then be linked to problematic alcohol use.

Rationale for Current Study

Sleep and craving research suggest a bidirectional relationship, in which craving effects sleep problems, and sleep dysfunction drives persistent cravings, while depression and alcohol craving research suggest that severe depressive symptoms may drive alcohol craving. However, it remains unclear how depression and alcohol craving may interact to influence sleep quality and alcohol use. Most of the existing research on sleep and craving in connection with substance use and withdrawal has been conducted in treatment or general adult populations, whereas little research has focused on the link between sleep and craving among emerging adults. This is problematic given that emerging adults drink at higher rates than any other age group (Hingson et al., 2017), seventy percent of emerging adults are sleep deprived (Lund et al., 2010) and 36% experience depression. Given that depression and craving research suggest that severe depressive symptoms may drive alcohol craving, it is imperative to incorporate both depression and craving when assessing the relations between sleep and alcohol use. Overall, a large body of work has shown associations between sleep quality, depression, and level of alcohol craving with alcohol use and related consequences, however, much of prior research have assessed these constructs separately in relation to alcohol use and not within the emerging adult population.

Given the lack of research examining the effects of depression and alcohol craving on the relationship between sleep quality and alcohol use, the current study aimed to elucidate the relationship between these variables within the emerging adult population to inform future intervention methods. It was hypothesized that:

1) Alcohol craving, alcohol use, sleep quality, and depression would be significantly associated with each other such that:

   a. Sleep quality would be negatively associated with alcohol craving and alcohol use (lower sleep quality would be associated with higher alcohol craving and alcohol use).
   b. Depression symptoms would be positively associated with alcohol craving and alcohol use (higher depression symptoms would be associated with higher alcohol craving and alcohol use).

2) Depression would moderate the association between sleep quality and alcohol use, such that the connection between sleep quality and alcohol use would be strongest for individuals with more depression symptoms.

3) Alcohol craving would mediate the relationship between sleep quality and alcohol use.

4) The indirect association between sleep quality and alcohol use through alcohol craving would be moderated by depression symptoms.

Material and Methods

Participants

To increase generalizability to emerging adults across the United States, participants were recruited from Prolific Academic. Prolific Academic allows for researchers to identify a target population, thus only individuals who lived in the United States and were emerging adults ages 18-35 were sampled. The inclusion criteria to participate in this study were (a) to be between ages 18 and 35 years old, (b) be a resident in the United States, and (c) have English as their first language. In total there were 375 participants recruited through Prolific Academic. During data cleaning, there were 2 participants removed for being over age 35, bringing the sample to 373 participants with an average age of 24.63 years old (*SD* = 3.12; range: 18-35). Participants

identified as 54.2% Male, 38.3% Female, 5.4% Non-Binary, 1.3% Transgender, and .8% reported "Other". Regarding ethnicity, 56.6% were White, 11.5% Asian, 11.5% reported multiple races, 11% Black, 8.6% Hispanic, .3% Pacific Islander or Native Hawaiian, .3% Middle Eastern, and .3% preferred not to answer. Additionally, 30% reported being a current college student (n = 112). Since the participants in this study may not have been of legal age to consume alcohol, participants were informed that their responses would be confidential and there would be no consequences for their responses.

Procedure

Prior to data collection, Western Kentucky University's Institutional Review Board reviewed and approved the study. When the approval was received, the survey was available on the Prolific Academic database. Individuals clicked on the Qualtrics link to the survey, and this took them to review the informed consent, which addressed the purpose of the study, the explanation of procedures, confidentiality, risks and benefits, and the right to terminate participation at any point. Participants signed the form electronically to begin the study, if they did not consent, they were redirected to the Prolific database. Participants were informed that their responses would be completely confidential and that they could withdraw from the study at any point in time without any consequences. To promote participation, participants were paid $11.49 per hour for their participation in the study according to Prolific guidelines. The study took a median of 20 minutes to complete. Following completion of the questionnaire, the debriefing document was displayed on the screen and there was a question in place ensuring the participant read and understood the document in its entirety.

Measures

Demographics. Participants completed a brief questionnaire detailing their age, sex, gender, ethnicity, sexual orientation, level of education, and military status.

Daily Drinking Questionnaire. The Daily Drinking Questionnaire (DDQ) was used to assess the number of drinks consumed in a typical week within the past month (Collins et al., 1985). This was a self-report measure where for each day of the week, participants indicated the typical number of drinks they have consumed and how many hours they consumed alcohol for that day using open-ended responses. An example question was, "On a typical Wednesday, I have __ drinks". There were seven items that corresponded to the seven days of the week, that included number of hours they consumed the drinks and number of drinks consumed (see Appendix A). To obtain the total score from the DDQ, a total drinks per week score was computed by summing the 7 days of the week items. The scores for these 7 items on the DDQ were continuous, so higher scores on this measure indicated more drinks per week. The DDQ has been identified as a valid measure of alcohol use among the college student population (Witkiewitz et al., 2014) and previous studies have has demonstrated that the DDQ is highly correlated with other measures of alcohol consumption (Kivlahan et al., 1990). Moreover, the DDQ has demonstrated good test-retest reliability (Neighbors et al., 2006) and good criterion validity (Neighbors et al., 2004). Internal consistency for the current study was good ($\alpha = .85$). This variable was referenced as "Alcohol Use".

Brief Young Adult Alcohol Consequences Questionnaire. The Brief-Young Adult Alcohol Consequences Scale (B-YAACQ) was used to measure alcohol-related consequences. This was a 24-item self-report questionnaire that measured the number of consequences related to alcohol use individuals have experienced in the past month (Kahler et al., 2005). Participants were asked to indicate if they experienced an alcohol-related consequence by responding "yes" or "no" to

each statement (see Appendix D). A total score was computed by summing the 24-items and scores could have ranged from 0 to 24. Internal consistency for the current study was excellent (α = .92). This variable was referenced as “Alcohol-related Consequences”.

Penn Alcohol Craving Scale. The Penn Alcohol Craving Scale (PACS) was used to measure past week alcohol craving. This was a 5-item self-report questionnaire that measured an individual’s craving to drink alcohol in the past week (Flannery et al., 1999). The first three questions assessed frequency, intensity, and duration of thoughts about drinking. The fourth question asked the participant to rate their ability to resist drinking. The last question asked the participant to report their overall average-level of craving for alcohol in the past week. An example of a frequency question was, “During the past week, how often have you thought about drinking or about how good a drink would make you feel?” with answers “Never (0 times during the past week)”, “Rarely (1-2 times during the past week)”, “Occasionally (3-4 times during the past week)”, “Sometimes (5-10 times during the past week)”, “Often (11-20 times during the past week)”, “Most of the time (20-40 times during the past week)”, or “Nearly all of the time (more than 40 times during the past week or more than 6 times per day)” (see Appendix C). Each question was scaled from 0 to 6 and increased in order of severity. The total score from the PACS was computed by summing the 5 items in the scale and the range of scores could have been between 0 and 30. Greater scores on this measure indicated higher alcohol craving levels in the past week. This scale has demonstrated good construct validity, discriminant validity, and predictive validity (Flannery et al., 1999). Internal consistency for the current study was high (α = .93). This variable was referenced as “Alcohol Craving”.

Depression, Anxiety, and Stress Scale. The Depression Anxiety and Stress Scale (DASS-21) was used to assess depression symptoms with the depression subscale of this measure. The

full scale was a 21-item self-report scale that was divided into three subsections that assessed the emotional states of depression, anxiety, and stress (Lovibond, 1995). Each subscale contained 7 items. The depression subscale assessed dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and inertia. The anxiety subscale assessed arousal, situational anxiety, and the subjective experience of anxious affect. The stress subscale assessed difficulty relaxing, nervous arousal, and being easily upset/agitated. Participants were asked to indicate how much a statement applies to them over the past week on a four-point Likert scale from "Did not apply to me at all" = 0 to "Applied to me very much or most of the time" = 3 (see Appendix E). Higher scores on this measure indicated the severity of their depression, anxiety, or stress. Each subscale was summed and multiplied by 2 to create a total score for depression, anxiety, and stress, thus the range of scores for each subscale could be between 0 and 42. This scale has demonstrated high internal consistency for each subscale with Cronbach alpha's of $\alpha = 0.95$, $\alpha = 0.87$, and $\alpha = 0.91$ for depression, anxiety, and stress respectively. Because we are only looking at depression scores, scores on the depression subscale were referenced as "Depression".

Pittsburgh Sleep Quality Index. The Pittsburgh Sleep Quality Index (PSQI) was used to assess poor sleep quality. This was a 19-item self-report scale that assessed past-month sleep habits, including average bed and rise times, total hours slept per night, trouble sleeping, use of sleeping pills, and daytime drowsiness (Buysse et al., 1989). There were seven components derived from the measure that consist of subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction (Buysse et al., 1989) (see Appendix B). This was a continuous measure in which higher scores indicated worse sleep quality. To obtain the total score from the PSQI, a global score was computed by

taking the 7 component scores and summing them together, and scores could range from 0 to 21. A greater global score on the PSQI indicated worse sleep quality and a score of 5 or above indicated clinically relevant insomnia. Moreover, this measure has been previously used with a college student population and has demonstrated moderate convergent validity compared to measure of insomnia and fatigue (Dietch et al., 2016). Internal consistency for the current study was fair ($\alpha = .72$). This variable was referenced as "Poor Sleep quality".

Data Analysis Plan

Data were analyzed using IBM Statistical Pack for Social Sciences (SPSS) 27 software. Baseline descriptive statistics of the overall sample were analyzed, including demographic information, as well as means and standard deviations of outcome variables. Bivariate correlations were used to determine associations between variables of interest (hypothesis 1a and 1b).

To test the second hypothesis that depression would moderate the association between sleep quality and alcohol use, such that the connection between sleep quality and alcohol use will be strongest for individuals with more depression symptoms, a moderation analysis was performed using the PROCESS Macro model 1 (Hayes, 2013). The global score of the PSQI was entered as the predictor variable, the DDQ total score served as the outcome variable representing total drinks per week, and the depression subscale score of the DASS-21 was entered as the moderator variable.

To test the third hypothesis, that alcohol craving would mediate the relations between sleep quality and alcohol use, a mediation analysis was performed using the PROCESS Macro model 4 (Hayes, 2013). The global score of the PSQI was entered as the predictor variable, the DDQ total score served as the outcome variable representing total drinks per week, and the PACS total score was the mediator variable.

To test the final hypothesis, that the indirect association between sleep and alcohol use through alcohol craving would be moderated by depression symptoms, a moderated mediation analysis was conducted using the PROCESS Macro model 8 (Hayes, 2013). The global score of the PSQI was entered as the predictor variable, the DDQ total score served as the outcome variable representing total drinks per week, PACS total score was the mediator variable, and the depression subscale score of the DASS-21 was entered as the moderator variable. See figure 2 for hypothesized model.

Results

Descriptive Statistics

On average, participants reported an average of 4.84 drinks per week (*SD* = 8.41; range: 0-70) and an average of 3.02 (*SD* = 4.63; range: 0-22) alcohol-related consequences in the past month. Additionally, participants had an average depression score of 12.19 (*SD* = 12.49; range: 0-42); 7.2% of participants met the criteria for severe depression, while 16.9% reported extremely severe depression. Participants reported an average score of 6.95 (*SD* = 3.70; range: 0-19) on the measure of global poor sleep quality, moreover 72.4% reported clinically relevant insomnia (i.e., PSQI global score > 5). Last, participants reported an average alcohol craving score of 4.30 (*SD* = 4.91; range: 0-26) during the past week. Means and standard deviations for these variables are shown in Table 1.

Bivariate Correlations

Table 2 represents the results of the bivariate correlation analyses used to determine associations among alcohol use, alcohol-related consequences, alcohol craving, poor sleep quality, and depression. This also included the test of hypotheses 1a and 1b. The results of the bivariate correlations demonstrated that alcohol use was positively associated with alcohol craving ($r = .61$, $p < .001$) and alcohol-related consequences ($r = .58$, $p < .001$). Poor sleep quality

was positively associated with depression (r = .55, p <.001), alcohol-related consequences (r = .14, p = .015), and alcohol craving (r = .20, p <.001). Depression was positively associated with alcohol-related consequences (r = .20, p <.001) and alcohol craving (r = .27, p <.001). Last, alcohol craving was positively associated with alcohol-related consequences (r = .60, p <.001).

Moderation Analysis

Table 3 represents the results of the moderation analysis used to determine if scores on depression moderated the relationship between sleep quality and alcohol use (hypothesis 2). The results indicated that the poor sleep quality x depression interaction (B = .01, p = .438, 95% C.I.: [-.01, .03]) was not significantly associated with alcohol use.

Mediation Analysis

Table 4 represents the results of the mediation analysis used to determine if alcohol craving mediated the relationship between poor sleep quality and alcohol use (hypothesis 3). The results indicated there was a significant direct effect between poor sleep quality and alcohol use (B = -.23, p = .017), and path a (poor sleep quality to alcohol craving) (B = .26, p = <.001), and path b (alcohol craving to alcohol use) (B = 1.10, p = <.001) were both significant. The total effect of this model was not significant (B =.05, p = .643, 95% C.I.: [-.18, .29]). The indirect effects of alcohol craving on the relationship between poor sleep quality and alcohol use was significant (B = .28) with a 95% confidence interval of [.12, .47]. This 95% confidence interval excluded zero, thus alcohol craving was a mediator in this relationship. See Figure 1.

Moderated Mediation Analysis

Table 5 represents the results of the moderated mediation analysis to determine if the indirect effect of alcohol craving on the relationship of poor sleep quality and alcohol use would be stronger for those who reported higher depression scores. The results indicated depression scores

did not moderate the direct effect of poor sleep quality on alcohol craving (B = .003, p = .525, 95% C.I.: [-.01, .01]) nor did depression moderate the direct effect of poor sleep quality on alcohol use (B = .004, p = .628, 95% C.I.: [-.01, .02]). The conditional direct effects on poor sleep quality and alcohol use by depression scores at one standard deviation below and above the mean were not significant, nor were the conditional indirect effects of poor sleep quality to alcohol craving to alcohol use by depression scores one standard deviation below and above the mean. Depression did not moderate the indirect association (via alcohol craving) between poor sleep quality and alcohol use [bootstrap estimate = .004, 95% C.I.: [-.01-.02]). The confidence interval included zero, indicating depression did not moderate the total indirect effect model.

Discussion

Alcohol use among emerging adults is a serious public health concern and research is needed to understand underlying factors impacting heavy alcohol use among this population. There are many factors that may contribute to alcohol use, such as depression, poor sleep quality, and alcohol craving. The purpose of the present study was to examine how alcohol craving and depression affect the relationship between sleep quality and alcohol use in emerging adults. Our results demonstrated that poor sleep quality and depression were not associated with alcohol use, but they were associated with more alcohol-related consequences and alcohol craving. Further, depression did not moderate the association between poor sleep quality and alcohol use. Alcohol craving did mediate the relationship between poor sleep quality and alcohol use. Lastly, depression did not moderate the indirect effect of alcohol craving on the association between poor sleep quality and alcohol use. Overall, the results have provided support for alcohol craving as a mediator of the connection between poor sleep quality and alcohol use, and demonstrated significant associations between alcohol use, poor sleep quality, depression, and alcohol craving.

Hypothesis 1a was partially supported in that poor sleep quality was associated with more alcohol craving, but not more alcohol use. This was consistent with past research showing that individuals with poor sleep also have higher levels of alcohol craving (Graupensperger et al., 2022). Additionally, hypothesis 1b was partially supported in that higher depressive symptoms were associated with more alcohol craving, but not more alcohol use. This was consistent with past research indicating levels of alcohol craving were strongly associated with levels of depression symptoms (Gordon et al., 2006). However, both depression and sleep quality were not associated with alcohol use in the present sample. This finding was surprising, given past research showing individuals with poor sleep had higher alcohol use (Miller et al., 2017). However, Miller and colleagues' (2017) study was conducted with an adolescent sample rather than emerging adults, who exhibit more alcohol use and worse sleep quality (Lund et al., 2010). In addition, the majority of previous studies were conducted with primarily adolescent and college student samples, while the current study was conducted with a crowdsourced sample of emerging adults made up of only 30% college students. Perhaps the association between poor sleep and alcohol use was stronger among adolescents and college students compared to a crowdsourced sample of mostly non-college emerging adults. Future research should examine whether poor sleep quality, depression, and alcohol use are related in community samples.

While poor sleep quality and alcohol use were not significantly associated, poor sleep quality and alcohol-related consequences were significantly positively correlated. This result was consistent with past research indicating that poor sleep and higher alcohol use predicted more alcohol-related consequences in college students (Miller et al., 2016). This may suggest that poor sleep quality was associated with a riskier pattern of alcohol use (as suggested by the association with greater numbers of alcohol related problems) rather than consuming more drinks per week.

Hypothesis 2 was not supported in that depressive symptoms did not moderate the association between alcohol use and poor sleep quality. This result was surprising given past research that has shown that poor sleep was associated with heavier alcohol use and greater depressive symptoms (Barahona-Correa et al., 2018). However, Kenney and colleagues'(2013) path-analytic model showed poor mental health (i.e., depression) leading to poor sleep, which led to alcohol use, so poor mental health was not directly predictive of alcohol use in their model. Other research has also shown that among college students there was no direct association between depression and alcohol use (Geisner et al., 2004). It is possible that our results were impacted by the relatively low levels of depression symptoms in the present sample. Our sample had an average depression score of 12.20, which according to the DASS-21 severity index, represents mild depression symptoms (for comparison, severe depression symptoms have a cutoff score of 21 or above). Barahona-Correa and colleagues (2018) examined how participants' sleep quality changed with meeting DSM-IV criteria for depression and found that a high frequency of participants that met the criteria for depression also reported having poor sleep quality. Most of the current sample (30%) had a normal range of depression symptoms (between 1 and 9) and 22% reported 0 depressive symptoms. It is likely that different results would be obtained by examining this research question in a sample of clinically depressed emerging adults.

Hypothesis 3 was supported in that alcohol craving mediated the relationship between sleep quality and alcohol use. This was consistent with past research indicating individuals with poor sleep quality reported having higher alcohol craving (Chakravorty et al., 2010; Graupensperger et al., 2022). Although Chakravorty and colleagues (2010) had a sample of individuals with alcohol use disorder, the current study was the first to examine this relationship in emerging

adults not diagnosed with alcohol use disorder. Previous research has also demonstrated alcohol craving mediating the relationship of impulsivity to alcohol use in college students (Flaudias et al., 2019), but that study did not examine the effects of poor sleep quality. Although, Graupensperger and colleagues (2022) found that low sleep duration during a two-week period was associated with an increased alcohol craving level in addition to increase alcohol use, they did not examine if low sleep duration led to more alcohol use through the mechanism of alcohol craving. The current finding that sleep quality and alcohol use were indirectly associated through alcohol craving is consistent with ego-depletion theory. Ego-depletion theory has stated when an individual experiences a depletion in cognitive resources, this leads to impaired self-regulation and poor self-control (Baumeister et al., 1998). Perhaps when individuals experience poor sleep quality, their cognitive resources (i.e., inhibitory control, executive functioning, decision making) are deprived, leading them to have poorer self-regulation. In turn, this could result in individuals experiencing more alcohol craving and being more likely to engage in alcohol use (Christiansen et al., 2012). The current study provided support for this theory by demonstrating how poor sleep quality (ego depletion) and alcohol use (poor self-regulation) are associated through alcohol craving (poor self-control). Further, this result represented a novel finding, that alcohol craving may be a mechanism linking poor sleep to alcohol use in a non-clinical, non-treatment seeking sample of emerging adults, while previous research has primarily focused on treatment seeking samples. Findings from the current study have indicated that improving sleep quality and reducing alcohol craving in prevention and intervention methods may be beneficial in reducing alcohol use in this population.

Hypothesis 4 was not supported as depressive symptoms did not moderate the indirect effect of alcohol craving on the association between sleep quality and alcohol use. This suggests that

different levels of depression symptoms did not change how alcohol craving impacts sleep quality and alcohol use in the present sample. This result was not surprising given that depression was not found to moderate the association between sleep quality and alcohol use in our sample. Sleep quality was linked to alcohol use through alcohol craving regardless of whether individuals have low or high levels of depression symptoms. Kenney and colleagues (2013)'s path-analytic model with a large sample of college students showed a direct association between poor mental health and alcohol-related consequences and an indirect association between poor mental health and alcohol use through poor sleep quality. Although their study assessed alcohol use, depression, and poor sleep quality in college students, their samples' level of alcohol use was much higher with a mean of 10.97 drinks per week (SD = 9.65). The present study extends Kenny and colleagues' (2013) path-analytic model by not only including identical measures of alcohol use, poor sleep quality, and depression, but by also adding alcohol craving to the model as a mediator of the connection between sleep quality and alcohol use. Moreover, the current study had a more diverse sample makeup and different mean scores on outcome variables. It is possible that differences in the samples' levels of alcohol use may have influenced the discrepancies in findings.

Based on the current study's findings that alcohol craving mediated the relationship between sleep quality and alcohol use, prevention and intervention methods targeting alcohol craving may be beneficial in improving sleep quality and potentially reducing alcohol use and related consequences. Additionally, improving sleep quality may also reduce alcohol craving, alcohol use and related consequences. While there have been no studies combining sleep quality and alcohol craving in an intervention method targeting alcohol use and related consequences, there have been a few interventions developed to target sleep quality and alcohol craving

independently. Britton and colleagues (2010) used a mindfulness-meditation sleep intervention in a sample of adolescents in an attempt to improve sleep quality, self-efficacy, and substance use. Participants completed a 6-session intervention with the first session dedicated to sleep education, and sessions 2 through 6 equally split between cognitive behavioral and mindfulness-based therapies. The results revealed that participation in this mindfulness meditation sleep intervention was associated with improved sleep quality and reduced substance use, and increased sleep duration was associated with improvements in psychological distress and reduced substance-related consequences (Britton et al., 2010). More recently, Fucito and colleagues (2017) tested a sleep intervention in a group of heavy-drinking college students and found that individuals in the sleep intervention condition, as well as the control condition of healthy behaviors, showed reductions in typical weekly alcohol use. The current study has suggested that for individuals who are receiving worse sleep, it seems as if they are craving alcohol more and that is what is driving them to drink more alcohol, rather than primarily poor sleep. Thus, targeting both poor sleep quality and alcohol craving in an intervention may be helpful in reducing alcohol use in this population. Previous research using cue-exposure therapy in a sample of individuals in an alcoholics anonymous group found that cue-exposure therapy reduced alcohol craving for this group (Lee et al., 2007). Cue-exposure therapy was used to diminish the conditioned relation between a substance-related cue (i.e., alcohol) and the physiological response to that cue (i.e., alcohol craving) while presenting the participant with both in a treatment setting (Hone-Blanchet et al., 2014). As the substance-related cue and the cue-elicited response are continuously paired together, the idea is that this would reduce the physiological reactivity (i.e., craving), which would lead to extinction of the cue and response association (Hone-Blanchet et al., 2014). Future studies should incorporate both the promotion of

healthy sleep habits and cue-exposure therapy for alcohol craving in an intervention to heavy-drinking emerging adults and examine whether these interventions lead to reductions in alcohol use and related consequences.

Limitations of the current study included that the data were collected via retrospective self-reports. The data may have been subject to bias because we asked about past month sleep, craving, depression symptoms, and substance use behaviors. This is sensitive information that may have made participants hesitant to answer truthfully. However, previous research within this population has shown that self-report drinking behaviors are reliable, due to the nature of the information remaining anonymous (Del Boca & Darkes, 2003). Moreover, the current study attempted to reduce these biases by reminding participants that their responses were confidential, there would be no consequences for their responses, and that they could leave the study at any time. However, to be more accurate in reporting their sleep and alcohol use behaviors, future research should utilize ecological momentary assessment (EMA) to prevent memory inaccuracies and to promote honesty in responses. By using EMA, participants would be asked about their drinking in the moment and about their sleep at bedtime and at wake time and their responses would be provided via an application on a mobile device such as a tablet or smartphone, so the responses would remain private and confidential. Moreover, to accurately depict overall sleep quality, future studies should use an objective sleep measure and measure sleep components through a smart watch to increase accuracy of reports of time spent asleep.

Further, the current study had a cross-sectional design, thus causal claims cannot be made. Although the current study reported a mediation analysis to help make causal claims, a more accurate causal claim should be reported with a longitudinal design instead. Thus, the current study could only report direct and indirect effects. Future research should incorporate studying

these variables longitudinally to capture the dynamic nature of variables such as sleep quality, alcohol craving, and alcohol use. These variables change daily and sometimes moment-to-moment (in the case of alcohol craving), thus studying these changes using EMA would more accurately capture how alcohol craving is indirectly driving the relationship between poor sleep quality and alcohol use. Another limitation is that depression symptoms were measured using the DASS-21 rather than a measure that assesses criteria for major depressive disorder. Future studies should use validated measures of DSM-V major depressive disorder to accurately measure depression symptoms. Last, the current sample was made up of both college students and non-college student emerging adults, which represents a strength and a potential limitation to the hypothesized models. Statistical associations between many of the hypothesized variables (alcohol use, alcohol-related consequences, sleep problems) may be stronger among college students rather than emerging adults. For example, college students report drinking more than other age groups (Hingson et al., 2017), have higher depressive symptoms, and report poorer sleep quality (Lund et al., 2010). Thus, examining these variables in a primarily college student sample may produce stronger effects of depression, alcohol use, and poor sleep quality.

Despite these limitations, the current study has significant public health relevance as it identifies alcohol craving as having a significant indirect effect on the relationship between poor sleep quality and alcohol use. Moreover, while the majority of studies examining these variables are conducted primarily with college students, the current study sampled both college and non-college seeking emerging adults and was primarily made up of non-college emerging adults. The current sample is also more diverse than those that have been used in previous studies. Although the majority of our sample is White, 43.4% of the sample is non-White. Thus, this sample can be more generalizable to emerging adults across the United States. Moreover, the current study used

a novel sampling technique with Prolific Academic. Prolific Academic provides researchers with more control over participant recruitment by allowing researchers to identify a specific inclusion criteria and only sampling based on that criteria. In the current study, the participants were sampled from across the United States, across ethnicities, and between ages 18 and 35. Thus, Prolific allowed for the opportunity to have a more diverse sample and it yields higher quality responses than Amazon's Mechanical Turk (Peer et al., 2017).

The current study provided new insight into how depression, poor sleep quality, and alcohol craving affect alcohol use among emerging adults. Results confirmed that there are associations between alcohol use, alcohol craving, and alcohol-related consequences. There were associations between poor sleep quality, depression, and alcohol-related consequences, as well as depression, alcohol craving, and alcohol-related consequences. The results also confirmed alcohol craving as a mediator of poor sleep quality and alcohol use. Last, the data were collected from emerging adults across the United States, allowing for a more representative sample and generalizability to similar populations.

Though this study provided nuanced information on how depression and alcohol craving affect poor sleep quality and alcohol use, there are some questions that are left unanswered that future studies could examine. Future research should replicate this study with an EMA design to capture the complex dynamic nature of sleep quality and alcohol craving. Previous research has shown that momentary craving is predictive of alcohol use (Ramirez & Miranda, 2014), and sleep quality could change daily and impact alcohol use (Chan et al., 2013), thus future research should study these associations in the moment to better understand how alcohol craving and poor sleep quality affect alcohol use. Further, the current study primarily examined alcohol use, but given the prevalence of alcohol-related consequences within this population, future research

should examine how alcohol craving, poor sleep quality, and depression affect alcohol-related consequences in addition to alcohol use. Moreover, because college students in particular experience more depression, poor sleep quality, and are exposed to more substance use due to the college environment (Lund et al., 2010), future research should examine this relationship among a diverse sample of college students.

Lastly, cannabis use is also prevalent among this population with 44% of college students and 43% of non-college students report using cannabis in the past year (NIDA, 2021). Given the high percentage of cannabis use in this population, future studies should examine how poor sleep quality and cannabis craving affects cannabis use and related consequences. Previous research has found that individuals may use cannabis as a sleep aid (Goodhines et al., 2019), and to reduce their depression and anxiety (Lai et al., 2015), thus future research should replicate this study with cannabis use to examine how depression or anxiety and cannabis craving impact poor sleep quality and cannabis use. Examining this relationship in other substances provides insight to underlying mechanisms affecting substance use and studying these mechanisms further can inform interventions and reduce consequences related substance use in this high-risk population.

REFERENCES

National Institute on Alcohol Abuse and Alcoholism (NIAAA). (2021). Https://Www.Niaaa.Nih.Gov/Publications/Brochures-and-Fact-Sheets/Alcohol-Facts-and-Statistics. https://www.niaaa.nih.gov/publications/brochures-and-fact-sheets/alcohol-facts-and-statistics

Barahona-Correa, J. E., Aristizabal-Mayor, J. D., Lasalvia, P., Ruiz, Á. J., & Hidalgo-Martínez, P. (2018). Sleep disturbances, academic performance, depressive symptoms and substance use among medical students in Bogota, Colombia. *Sleep Science*, *11*(4), 260–268. https://doi.org/10.5935/1984-0063.20180041

Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, *74*, 1252–1265. https://doi.org/10.1037/0022-3514.74.5.1252

Boden, J. M., & Fergusson, D. M. (2011). Alcohol and depression. *Addiction*, *106*(5), 906–914. https://doi.org/10.1111/j.1360-0443.2010.03351.x

Bresin, K., & Verona, E. (2021). Craving and substance use: Examining psychophysiological and behavioral moderators. *International Journal of Psychophysiology*, *163*, 92–103. https://doi.org/10.1016/j.ijpsycho.2019.03.006

Brière, F. N., Rohde, P., Seeley, J. R., Klein, D., & Lewinsohn, P. M. (2014). Comorbidity between major depression and alcohol use disorder from adolescence to adulthood. *Comprehensive Psychiatry*, *55*(3), 526–533. https://doi.org/10.1016/j.comppsych.2013.10.007

Britton, W. B., Bootzin, R. R., Cousins, J. C., Hasler, B. P., Peck, T., & Shapiro, S. L. (2010). The contribution of mindfulness practice to a multicomponent behavioral sleep

intervention following substance abuse treatment in adolescents: A treatment-development study. *Substance Abuse*, *31*(2), 86–97. https://doi.org/10.1080/08897071003641297

Brooks, P. R., Girgenti, A. A., & Mills, M. J. (2009). Sleep patterns and symptoms of depression in college students. *College Student Journal*, *43*(2), 464–472.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). Pittsburgh sleep quality index (PSQI). *Psychiatry Research*, *28*, 193–213.

Camatta, C. D., & Nagoshi, C. T. (1995). Stress, depression, irrational beliefs, and alcohol use and problems in a college student sample. *Alcoholism: Clinical and Experimental Research*, *19*(1), 142–146. https://doi.org/10.1111/j.1530-0277.1995.tb01482.x

Chakravorty, S., Kuna, S. T., Zaharakis, N., O'Brien, C. P., Kampman, K. M., & Oslin, D. (2010). Covariates of craving in actively drinking alcoholics. *The American Journal on Addictions*, *19*(5), 450–457. https://doi.org/10.1111/j.1521-0391.2010.00067.x

Chan, J. K. M., Trinder, J., Andrewes, H. E., Colrain, I. M., & Nicholas, C. L. (2013). The acute effects of alcohol on sleep architecture in late adolescence. *Alcohol: Clinical and Experimental Research*, *37*(10), 1720–1728. https://doi.org/10.1111/acer.12141

Christiansen, P., Cole, J. C., & Field, M. (2012). Ego depletion increases ad-lib alcohol consumption: Investigating cognitive mediators and moderators. *Experimental and Clinical Psychopharmacology*, *20*, 118–128. https://doi.org/10.1037/a0026623

Cohn, T. J., Foster, J. H., & Peters, T. J. (2003). Sequential studies of sleep disturbance and quality of life in abstaining alcoholics. *Addiction Biology*, *8*(4), 455–462. https://doi.org/10.1080/13556210310001646439

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology*, *53*(2), 189–200. https://doi.org/10.1037/0022-006X.53.2.189

Del Boca, F. K., & Darkes, J. (2003). The validity of self-reports of alcohol consumption: State of the science and challenges for research. *Addiction*, *98*(s2), 1–12. https://doi.org/10.1046/j.1359-6357.2003.00586.x

Dietch, J. R., Taylor, D. J., Sethi, K., Kelly, K., Bramoweth, A. D., & Roane, B. M. (2016). Psychometric evaluation of the PSQI in U.S. college students. *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*, *12*(8), 1121–1129. https://doi.org/10.5664/jcsm.6050

Dunbar, M. S., Shiffman, S., Kirchner, T. R., Tindle, H. A., & Scholl, S. M. (2014). Nicotine dependence, "background" and cue-induced craving and smoking in the laboratory. *Drug and Alcohol Dependence*, *142*, 197–203. https://doi.org/10.1016/j.drugalcdep.2014.06.018

Fatseas, M., Serre, F., Alexandre, J.-M., Debrabant, R., Auriacombe, M., & Swendsen, J. (2015). Craving and substance use among patients with alcohol, tobacco, cannabis or heroin addiction: A comparison of substance- and person-specific cues. *Addiction*, *110*(6), 1035–1042. https://doi.org/10.1111/add.12882

Ferguson, S. G., & Shiffman, S. (2009). The relevance and treatment of cue-induced cravings in tobacco dependence. *Journal of Substance Abuse Treatment*, *36*(3), 235–243. https://doi.org/10.1016/j.jsat.2008.06.005

Flannery, B. A., Volpicelli, J. R., & Pettinati, H. M. (1999). Psychometric properties of the Penn Alcohol Craving Scale. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1530-0277.1999.tb04349.x?casa_token=kj7Z29v-Q2IAAAAA:Q0qmATj4BQLXEnYueKNa-Fqeh1xRUn5BiV6EFehyWicjoiIBUIKSSgDEF-ZRZgPvjS8gReciAZpkMQ

Flaudias, V., Maurage, P., Izaute, M., Chazeron, I., Brousse, G., Chakroun-Baggioni, N., de Chazeron, I., & Chakroun-Baggioni, N. (2019). Craving mediates the relation between impulsivity and alcohol consumption among university students. *American Journal on Addictions*, *28*(6), 489–496. https://doi.org/10.1111/ajad.12944

Freeman, L. K., & Gottfredson, N. C. (2018). Using ecological momentary assessment to assess the temporal relationship between sleep quality and cravings in individuals recovering from substance use disorders. *Addictive Behaviors*, *83*, 95. https://doi.org/10.1016/j.addbeh.2017.11.001

Fucito, L. M., DeMartini, K. S., Hanrahan, T. H., Yaggi, H. K., Heffern, C., & Redeker, N. S. (2017). Using sleep interventions to engage and treat heavy-drinking college students: A randomized pilot study. *Alcoholism, Clinical and Experimental Research*, *41*(4), 798–809. https://doi.org/10.1111/acer.13342

Geisner, I. M., Larimer, M. E., & Neighbors, C. (2004). The relationship among alcohol use, related problems, and symptoms of psychological distress: Gender as a moderator in a college sample. *Addictive Behaviors*, *29*(5), 843–848. https://doi.org/10.1016/j.addbeh.2004.02.024

Gillin, C. J., & Wallace, D. (1979). Successful separation of depressed, normal, and insomniac subjects by EEG sleep data | *JAMA Psychiatry* | *JAMA Network*. https://jamanetwork.com/journals/jamapsychiatry/article-abstract/492041

Goodhines, P. A., Gellis, L. A., Ansell, E. B., & Park, A. (2019). Cannabis and alcohol use for sleep aid: A daily diary investigation. *Health Psychology*, *38*, 1036–1047. https://doi.org/10.1037/hea0000765

Goodhines, P. A., Gellis, L. A., Kim, J., Fucito, L. M., & Park, A. (2019). Self-medication for sleep in college students: Concurrent and prospective associations with sleep and alcohol behavior. *Behavioral Sleep Medicine*, *17*(3), 327–341. https://doi.org/10.1080/15402002.2017.1357119

Gordon, S. M., Sterling, R., Siatkowski, C., Raively, K., Weinstein, S., & Hill, P. C. (2006). Inpatient desire to drink as a predictor of relapse to alcohol use following treatment. *The American Journal on Addictions*, *15*(3), 242–245. https://doi.org/10.1080/10550490600626556

Graupensperger, S., Fairlie, A. M., Ramirez, J. J., Calhoun, B. H., Patrick, M. E., & Lee, C. M. (2022). Daily-level associations between sleep duration and next-day alcohol and cannabis craving and use in young adults. *Addictive Behaviors*, *132*, 107367. https://doi.org/10.1016/j.addbeh.2022.107367

Hayes, A. F. (2013). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford Press.

Hingson, R. W., Zha, W., & Weitzman, E. R. (2009). Magnitude of and trends in alcohol-related mortality and morbidity among U.S. college students ages 18-24, 1998-2005. *Journal of Studies on Alcohol and Drugs. Supplement*, *16*, 12–20. https://doi.org/10.15288/jsads.2009.s16.12

Hingson, R., Zha, W., & Smyth, D. (2017). Magnitude and trends in heavy episodic drinking, alcohol-impaired driving, and alcohol-related mortality and overdose hospitalizations

among emerging adults of college ages 18–24 in the United States, 1998–2014. *Journal of Studies on Alcohol and Drugs, 78*(4), 540–548. https://doi.org/10.15288/jsad.2017.78.540

Hone-Blanchet, A., Wensing, T., & Fecteau, S. (2014). The use of virtual reality in craving assessment and cue-exposure therapy in substance use disorders. *Frontiers in Human Neuroscience, 8*. https://www.frontiersin.org/articles/10.3389/fnhum.2014.00844

Johnston, L. D., Miech, R. A., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Patrick, M. E. (2020). Monitoring the future national survey results on drug use, 1975-2019: Overview, Key Findings on Adolescent Drug Use. In *Institute for Social Research*. Institute for Social Research. https://eric.ed.gov/?id=ED604018

Kahler, C. W., Strong, D. R., & Read, J. P. (2005). Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The brief young adult alcohol consequences questionnaire. *Alcoholism, Clinical and Experimental Research, 29*(7), 1180–1189. https://doi.org/10.1097/01.alc.0000171940.95813.a5

Kavanagh, D. J., & Connor, J. P. (2013). Craving: A research update. *Addictive Behaviors, 38*(2), 1499–1500. https://doi.org/10.1016/j.addbeh.2012.08.001

Kenney, S. R., Lac, A., LaBrie, J. W., Hummer, J. F., & Pham, A. (2013). Mental health, sleep quality, drinking motives, and alcohol-related consequences: A path-analytic model. *Journal of Studies on Alcohol and Drugs, 74*(6), 841–851.

Killgore, W. D. S., Balkin, T. J., & Wesensten, N. J. (2006). Impaired decision making following 49 h of sleep deprivation. *Journal of Sleep Research, 15*(1), 7–13. https://doi.org/10.1111/j.1365-2869.2006.00487.x

Kivlahan, D., Marlatt, G. A., Fromme, K., Coppel, D. B., & Williams, E. (1990). Secondary prevention of alcohol-related problems in young adults at risk. (K. D. Craig & S. M. Weiss, Eds.). Springer Publishing Company.

Kwon, M., Seo, Y. S., Park, E., & Chang, Y.-P. (2020). Association between substance use and insufficient sleep in U.S. high school students. *The Journal of School Nursing*, 1059840519901161. https://doi.org/10.1177/1059840519901161

Lai, H. M. X., Cleary, M., Sitharthan, T., & Hunt, G. E. (2015). Prevalence of comorbid substance use, anxiety and mood disorders in epidemiological surveys, 1990–2014: A systematic review and meta-analysis. *Drug and Alcohol Dependence*, *154*, 1–13. https://doi.org/10.1016/j.drugalcdep.2015.05.031

Lee, J.-H., Kwon, H., Choi, J., & Yang, B.-H. (2007). Cue-exposure therapy to decrease alcohol craving in virtual environment. *CyberPsychology & Behavior*, *10*(5), 617–623. https://doi.org/10.1089/cpb.2007.9978

Lovibond, S. H., Lovibond, Peter F., Psychology Foundation of Australia. (1995). Manual for the depression anxiety stress scales. Psychology Foundation of Australia; /z-wcorg/.

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health*, *46*(2), 124–132. https://doi.org/10.1016/j.jadohealth.2009.06.016

Lydon-Staley, D. M., Cleveland, H. H., Huhn, A. S., Cleveland, M. J., Harris, J., Stankoski, D., Deneke, E., Meyer, R. E., & Bunce, S. C. (2017). Daily sleep quality affects drug craving, partially through indirect associations with positive affect, in patients in treatment for nonmedical use of prescription drugs. *Addictive Behaviors*, *65*, 275–282. https://doi.org/10.1016/j.addbeh.2016.08.026

Mayers, A. G., Grabau, E. A. S., Campbell, C., & Baldwin, D. S. (2009). Subjective sleep, depression and anxiety: Inter-relationships in a non-clinical sample. *Human Psychopharmacology: Clinical and Experimental*, *24*(6), 495–501. https://doi.org/10.1002/hup.1041

McHugh, R. K., Fitzmaurice, G. M., Griffin, M. L., Anton, R. F., & Weiss, R. D. (2016). Association between a brief alcohol craving measure and drinking in the following week. *Addiction*, *111*(6), 1004–1010. https://doi.org/10.1111/add.13311

Miller, M. B., DiBello, A. M., Lust, S. A., Carey, M. P., & Carey, K. B. (2016). Adequate sleep moderates the prospective association between alcohol use and consequences. *Addictive Behaviors*, *63*, 23–28. https://doi.org/10.1016/j.addbeh.2016.05.005

Miller, M. B., Janssen, T., & Jackson, K. M. (2017). The prospective association between sleep and initiation of substance use in young adolescents. *Journal of Adolescent Health*, *60*(2), 154–160. https://doi.org/10.1016/j.jadohealth.2016.08.019

Neighbors, C., Dillard, A. J., Lewis, M. A., Bergstrom, R. K., & Neil, T. A. (2006). Normative misperceptions and temporal precedence of perceived norms and drinking. *Journal of Studies on Alcohol*, *67*(2), 290–299.

Neighbors, C., Larimer, M. E., & Lewis, M. A. (2004). Targeting misperceptions of descriptive drinking norms: Efficacy of a computer-delivered personalized normative feedback intervention. *Journal of Consulting and Clinical Psychology*, *72*(3), 434–447. https://doi.org/10.1037/0022-006X.72.3.434

NIDA. (2021). Marijuana use at historic high among college-aged adults in 2020. *National Institute on Drug Abuse*. https://nida.nih.gov/news-events/news-releases/2021/09/marijuana-use-at-historic-high-among-college-aged-adults-in-2020

Pasch, K. E., Latimer, L. A., Cance, J. D., Moe, S. G., & Lytle, L. A. (2012). Longitudinal bi-directional relationships between sleep and youth substance use. *Journal of Youth and Adolescence*, *41*(9), 1184–1196. https://doi.org/10.1007/s10964-012-9784-5

Peer, E., Brandimarte, L., Samat, S., & Acquisti, A. (2017). Beyond the turk: Alternative platforms for crowdsourcing behavioral research. *Journal of Experimental Social Psychology*, *70*, 153–163. https://doi.org/10.1016/j.jesp.2017.01.006

Ramirez, J., & Miranda, R. (2014). Alcohol craving in adolescents: Bridging the laboratory and natural environment. *Psychopharmacology*, *231*(8), 1841–1851. https://doi.org/10.1007/s00213-013-3372-6

Reynolds, C. F. (1987). Sleep and affective disorders: A minireview. *Psychiatric Clinics of North America*, *10*(4), 583–591. https://doi.org/10.1016/S0193-953X(18)30535-5

Rezaei, M., Khormali, M., Akbarpour, S., Sadeghniiat-Hagighi, K., & Shamsipour, M. (2018). Sleep quality and its association with psychological distress and sleep hygiene: A cross-sectional study among pre-clinical medical students. *Sleep Science*, *11*(4), 274–280. https://doi.org/10.5935/1984-0063.20180043

Rosenberg, H., & Mazzola, J. (2007). Relationships among self-report assessments of craving in binge-drinking university students. *Addictive Behaviors*, *32*(12), 2811–2818. https://doi.org/10.1016/j.addbeh.2007.04.019

Rush, B., Urbanoski, K., Bassani, D., Castel, S., Wild, T. C., Strike, C., Kimberley, D., & Somers, J. (2008). Prevalence of co-occurring substance use and other mental disorders in the canadian population. *The Canadian Journal of Psychiatry*, *53*(12), 800–809. https://doi.org/10.1177/070674370805301206

Sinha, R., & O'Malley, S. S. (1999). Craving for alcohol: Findings from the clinic and the laboratory. *Alcohol and Alcoholism*, *34*(2), 223–230. https://doi.org/10.1093/alcalc/34.2.223

Stein, M. D., & Friedmann, P. D. (2005). Disturbed sleep and its relationship to alcohol use. *Substance Abuse : Official Publication of the Association for Medical Education and Research in Substance Abuse*, *26*(1), 1–13.

Teeters, J. B., Jones, J. L., Jarnecke, A. M., & Back, S. E. (2020). Sleep moderates the relationship between stress and craving in individuals with opioid use disorder. *Experimental and Clinical Psychopharmacology*. https://doi.org/10.1037/pha0000372

Timary, P. de, Uva, M. C. de S., Denoël, C., Hebborn, L., Derely, M., Desseilles, M., & Luminet, O. (2013). The associations between self-consciousness, depressive state and craving to drink among alcohol dependent patients undergoing protracted withdrawal. *PLOS ONE*, *8*(8), e71560. https://doi.org/10.1371/journal.pone.0071560

Trela, C. J., Hayes, A. W., Bartholow, B. D., Sher, K. J., Heath, A. C., & Piasecki, T. M. (2018). Moderation of alcohol craving reactivity to drinking-related contexts by individual differences in alcohol sensitivity: An ecological investigation. *Experimental and Clinical Psychopharmacology*, *26*(4), 354. https://doi.org/10.1037/pha0000206

Weitzman, E. R. (2004). Poor mental health, depression, and associations With alcohol consumption, harm, and abuse in a national sample of young adults in college. *The Journal of Nervous and Mental Disease*, *192*(4), 269–277. https://doi.org/10.1097/01.nmd.0000120885.17362.94

Witkiewitz, K., & Bowen, S. (2010). Depression, craving and substance use following a randomized trial of mindfulness-based relapse prevention. *Journal of Consulting and Clinical Psychology*, *78*(3), 362–374. https://doi.org/10.1037/a0019172

Witkiewitz, K., Desai, S. A., Bowen, S., Leigh, B. C., Kirouac, M., & Larimer, M. E. (2014). Development and evaluation of a mobile intervention for heavy drinking and smoking among college students. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors*, *28*(3), 639–650. https://doi.org/10.1037/a0034747

Table 1.

Means and standard deviations for age and outcome variables.

Variable	*N*	Mean	*SD*	Minimum	Maximum
Age	373	24.63	3.12	18.00	35.00
Alcohol Use	373	4.84	8.42	0.00	70.00
Poor Sleep Quality	373	6.95	3.70	0.00	19.00
Alcohol Craving	373	4.30	4.91	0.00	26.00
Alcohol-related Consequences	328	3.02	4.63	0.00	22.00
Depression	373	12.19	12.49	0.00	42.00

Note: *SD*, Standard deviation.

Table 2

Bivariate correlations between Alcohol Use, poor Sleep Quality, Alcohol Craving, Alcohol-related Consequences, and Depression.

	1.	2.	3.	4.	5.
1. Alcohol Use	1				
2. Poor Sleep Quality	.02	1			
3. Alcohol Craving	.61**	.20**	1		
4. Alcohol-related Consequences	.58**	.14*	.60**	1	
5. Depression	.04	.55**	.27**	.20**	1

Note. * = p <.05, ** = p <.001

Table 3.

Depression as a moderator of poor Sleep Quality and Alcohol Use.

Predictor	*B* (*SE*)	*p*	95% C.I.: [LL, UL]
Poor Sleep Quality x Depression	.01 (.01)	.438	[-.01, .03]

Note: *B*, Unstandardized regression coefficient; *SE,* Standard error; Confidence interval, 95%; LL, Lower limit; UL, Upper limit

Table 4.

Alcohol Craving as a mediator on poor Sleep Quality and Alcohol Use (PROCESS model 4, 95%CI).

	B (*SE*)	*p*	95% C.I.: [LL, UL]
Outcome: Alcohol Craving			
Intercept	2.50 (.53)	< .001*	[1.45, 3.54]
Poor Sleep Quality	.26 (.07)	< .001*	[.13, .39]
Outcome: Alcohol Use			
Intercept	1.75 (.75)	.020*	[.28, 3.23]
Poor Sleep Quality	-.23 (.09)	.017*	[-.41, -.04]
Alcohol Craving	1.10 (.07)	< .001*	[.94, 1.22]
Direct effect of poor Sleep Quality on Alcohol Use	-.23 (.0944)	.017*	[-.41, -.04]
Indirect effect of poor Sleep Quality on Alcohol Use via Alcohol Craving	.28 (.10)		[.12, .47]
Total effect	.05 (.12)	.643	[-.18, .29]

Note. * = $p < .05$; *B*, Unstandardized regression coefficient; *SE*, Standard error; Confidence interval, 95%; LL, Lower limit; UL, Upper limit

Table 5.

The moderated mediation analysis of Depression as a moderator and Alcohol Craving as a mediator on poor Sleep Quality and Alcohol Use (PROCESS model 8, 95% CI).

	B (*SE*)	*p*	95% C.I.: [LL, UL]
Outcome: Alcohol Craving			
Intercept	2.86 (.71)	< .001	[1.47, 4.26]
Poor Sleep Quality	.04 (.11)	.705	[-.18, .27]
Depression	.10 (.05)	.198	[-.03, .16]
Poor Sleep Quality x Depression	.003 (.01)	.525	[-.01, .01]
R^2	.08		
Outcome: Alcohol Use			
Intercept	1.95 (1.01)	.053	[-.03, 3.93]
Poor Sleep Quality	-.15 (.16)	.336	[-.46, .16]
Alcohol Craving	1.11 (.07)	< .001*	[.97, 1.26]
Depression	-.10 (.07)	.128	[-.23, .03]
Poor Sleep Quality x Depression	.003 (.01)	.628	[-.01, .02]
R^2	.39		
Conditional direct effect of poor Sleep Quality on Alcohol Use			
Depression -1SD below Mean (0)	-.15 (.16)	.336	[-.46, .16]
Depression Mean (12.19)	-.11 (.11)	.342	[-.33, .11]
Depression +1SD above Mean (24.68)	-.06 (.13)	.643	[-.32, .20]
Conditional indirect effect of poor Sleep Quality on Alcohol Use			
Depression -1SD below Mean (0)	.0476 (.1177)		[-.17, .29]
Depression Mean (12.19)	.0943 (.0903)		[-.07 .29]
Depression +1SD above Mean (24.68)	.1420 (.1342)		[-.10, .43]
Index of moderated mediation	**Index**	**Boot SE**	95% C.I.: [LL, UL]
	.004	.007	[-.01, .02]

Note: * = $p < .05$. $N = 373$; *B*, Unstandardized regression coefficient; *SE*, Standard error; Confidence interval, 95%; LL, Lower limit; UL, Upper limit

Figure 1

The Mediation Model of Alcohol Craving mediating the relationship between poor Sleep Quality and Alcohol Use

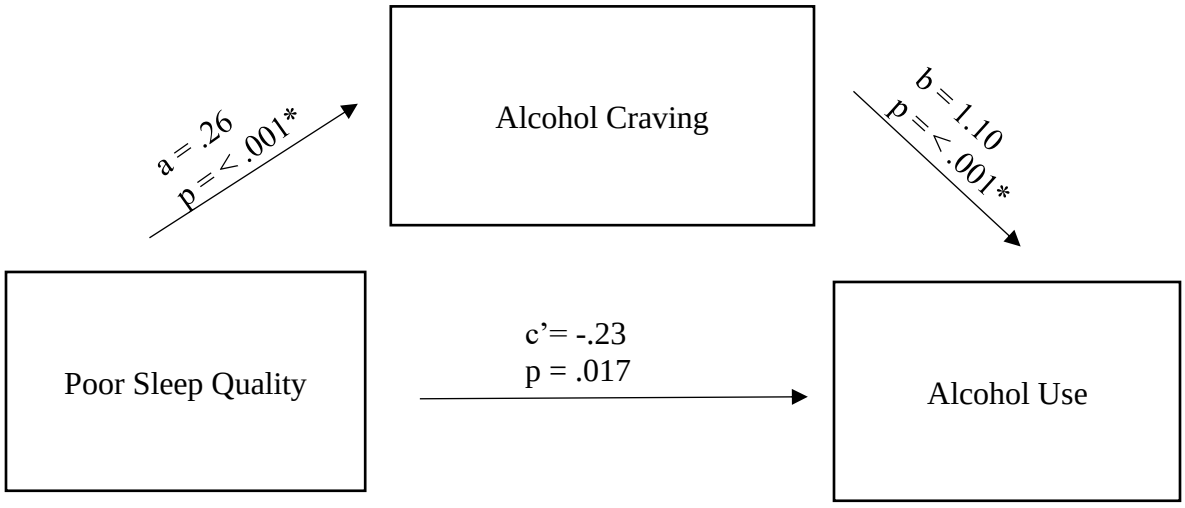
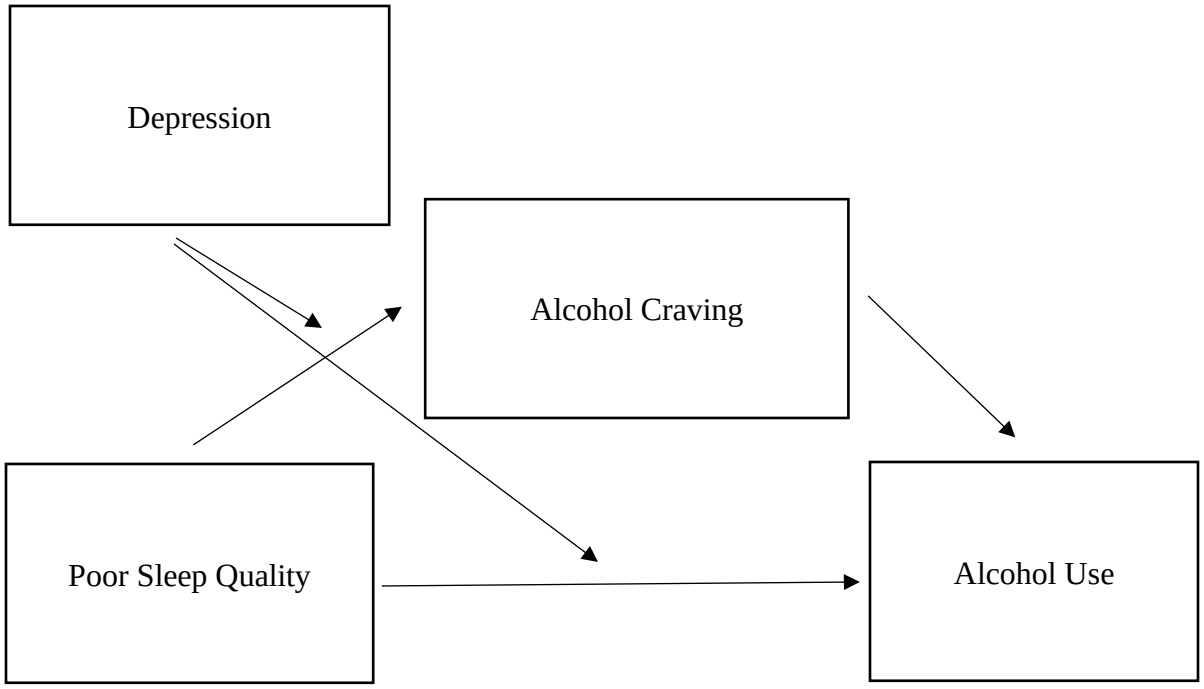


Figure 2.

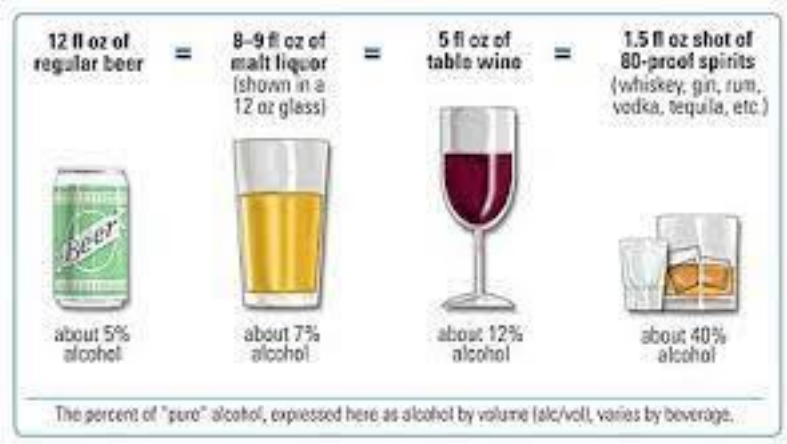
Hypothesized Moderated Mediation Model of Depression moderating the indirect effects of Alcohol Craving on the relationship between Sleep quality and Alcohol use.



APPENDIX A

The Daily Drinking Questionnaire (DDQ)

The questions below ask about your alcohol consumption. The image below can help you see what a standard drink looks like.



1. For the past month, fill in each calendar day the number of standard drinks you usually drink on that day during the typical week, and the number of hours over which you consume this amount (i.e., the time from 1st sip to last sip). When we say one drink we mean 12 oz. of beer, 5 oz of wine, or 1.5 oz. of hard liquor (see picture above). Malt liquor is stronger than regular beer, so one 40 oz. Malt liquor such as Colt 45 counts as 5 standard drinks. Fill in an amount for each of the 7 days. If you do not typically drink on a given day, fill in 0 for that day.

	# Of Drinks	# Of Hours
Monday	_____	_____
Tuesday	_____	_____
Wednesday	_____	_____
Thursday	_____	_____
Friday	_____	_____
Saturday	_____	_____
Sunday	_____	_____

Please provide the following information, which is necessary to estimate your blood alcohol level.

2. What is your current weight (in pounds)?

_____

3. What is your height (in feet and inches)? (example 5' 10")

_____

4. IN THE PAST MONTH how many times have you had 4 or more drinks (in one occasion)?(For females)

_____

5. How many times IN THE PAST MONTH have you had 4 or more drinks in 2 hours or less?(For females)

_____

6. IN THE PAST MONTH how many times have you had 5 or more drinks (in one occasion)?(For males)

_____

7. How many times IN THE PAST MONTH have you had 5 or more drinks in 2 hours or less? (For males)

_____

8. In the past month, how many times have you been drunk or intoxicated?

_____

9. What is the greatest number of standard drinks you have consumed in any one occasion over the past month? (One drink = 12oz beer, 5oz wine, 1.5oz hard liquor)

_____

10. Over how many hours did you consume these drinks (first sip to last sip)?

_____

APPENDIX B

Pittsburgh Sleep Quality Index (PSQI)

Name:_____ Date: _____

Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. **Please answer all questions.**

1. During the past month, what time have you usually gone to bed at night? _____
2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? _____
3. During the past month, what time have you usually gotten up in the morning? _____
4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.) _____

5. During the past month, how often have you had trouble sleeping because you…	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), please describe:				
6. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
8. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?				
	Very good	Fairly good	Fairly bad	Very bad
9. During the past month, how would you rate your sleep quality overall?				

	No bed partner or room mate	Partner/room mate in other room	Partner in same room but not same bed	Partner in same bed
10. Do you have a bed partner or room mate?				
	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
If you have a room mate or bed partner, ask him/her how often in the past month you have had:				
a. Loud snoring				
b. Long pauses between breaths while asleep				
c. Legs twitching or jerking while you sleep				
d. Episodes of disorientation or confusion during sleep				
e. Other restlessness while you sleep, please describe:				

APPENDIX C

Penn Alcohol Craving Scale (PACS)

Penn Alcohol Craving Scale (PACS)

PLEASE READ EACH ITEM CAREFULLY AND CIRCLE THE NUMBER THAT BEST DESCRIBES YOUR CRAVING *DURING THE PAST WEEK.*

1. During the past week *how often* have you thought about drinking or about how good a drink would make you feel?
   - 0 Never (0 times during the past week)
   - 1 Rarely (1 to 2 times during the past week)
   - 2 Occasionally (3 to 4 times during the past week)
   - 3 Sometimes (5 to 10 times during the past week or 1 to 2 times per day)
   - 4 Often (11 to 20 times during the past week or 2 to 3 times per day)
   - 5 Most of the time (20 to 40 times during the past week or 3 to 6 times per day)
   - 6 Nearly all of the time (more than 40 times during the past week or more than 6 times per day)

2. At its most severe point, *how strong* was your craving during the past week?
   - 0 None at all
   - 1 Slight, that is a very mild urge
   - 2 Mild urge
   - 3 Moderate urge
   - 4 Strong urge, but easily controlled
   - 5 Strong urge and difficult to control
   - 6 Strong urge and would have drunk alcohol if it were available

3. During the past week *how much time* have you spent thinking about drinking or about how good a drink would make you feel?
   - 0 None at all
   - 1 Less than 20 minutes
   - 2 21 to 45 minutes
   - 3 46 to 90 minutes
   - 4 90 minutes to 3 hours
   - 5 Between 3 to 6 hours
   - 6 More than 6 hours

4. During the past week *how difficult would it have been to resist* taking a drink if you had known a bottle were in your house?
   - 0 Not difficult at all
   - 1 Very mildly difficult
   - 2 Mildly difficult
   - 3 Moderately difficult
   - 4 Very difficult
   - 5 Extremely difficult
   - 6 Would not be able to resist

5. Keeping in mind your responses to the previous questions, please rate your overall *average alcohol craving* for the past week.
   - 0 Never thought about drinking and never had the urge to drink
   - 1 Rarely thought about drinking and rarely had the urge to drink
   - 2 Occasionally thought about drinking and occasionally had the urge to drink
   - 3 Sometimes thought about drinking and sometimes had the urge to drink
   - 4 Often thought about drinking and often had the urge to drink
   - 5 Thought about drinking most of the time and had the urge to drink most of the time
   - 6 Thought about drinking nearly all of the time and had the urge to drink nearly all of the time

APPENDIX D

Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ)

Here is a list of situations that, sometimes, happen to people during or after they have consumed alcoholic beverages. Next to each item shown below, mark each item as Yes or No to indicate if this item has happened in the last year.

In the last year… Yes or No

1. I have had a hangover (headache, sick stomach) the morning after I had been drinking
2. I have taken foolish risks when I have been drinking
3. I've not been able to remember large stretches of time while drinking heavily
4. The quality of my work or schoolwork has suffered because of my drinking
5. I have had less energy or felt tired because of my drinking
6. My drinking has gotten me into sexual situations I later regretted
7. I have often ended up drinking on nights when I had planned not to drink
8. My physical appearance has been harmed by my drinking
9. While drinking, I have said or done embarrassing things
10. I have felt very sick to my stomach or thrown up after drinking
11. I have not gone to work or missed classes at school because of drinking, a hangover, or illness caused by drinking
12. When drinking, I have done impulsive things I regretted later
13. I have been overweight because of drinking
14. I have woken up in an unexpected place after drinking
15. I have spent too much time drinking
16. I have felt badly because of my drinking
17. My drinking has caused problems between myself and my boyfriend/girlfriend/spouse/parents, or school or other near relatives
18. I have felt like I needed a drink after I'd gotten up (That is, before breakfast)
19. I have driven a car when I knew I had too much to drink to drive safely
20. I have neglected my obligations to family, work, or school because of drinking
21. I have often found it difficult to limit how much I drink
22. I have passed out from drinking
23. I have become very rude, obnoxious, or insulting after drinking
24. I have found that I needed larger amounts of alcohol to feel any effect, or that I could no longer get high or drunk on the amount that used to get me high or drunk

APPENDIX E

Depression, Anxiety, and Stress Scale (DASS)

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:
0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree or a good part of time
3 Applied to me very much or most of the time

1 (s) I found it hard to wind down	0 1 2 3
2 (a) I was aware of dryness of my mouth	0 1 2 3
3 (d) I couldn't seem to experience any positive feeling at all	0 1 2 3
4 (a) I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)	0 1 2 3
5 (d) I found it difficult to work up the initiative to do things	0 1 2 3
6 (s) I tended to over-react to situations	0 1 2 3
7 (a) I experienced trembling (e.g. in the hands)	0 1 2 3
8 (s) I felt that I was using a lot of nervous energy	0 1 2 3
9 (a) I was worried about situations in which I might panic and make a fool of myself	0 1 2 3
10 (d) I felt that I had nothing to look forward to	0 1 2 3
11 (s) I found myself getting agitated	0 1 2 3
12 (s) I found it difficult to relax	0 1 2 3
13 (d) I felt down-hearted and blue	0 1 2 3
14 (s) I was intolerant of anything that kept me from getting on with what I was doing	0 1 2 3
15 (a) I felt I was close to panic	0 1 2 3
16 (d) I was unable to become enthusiastic about anything	0 1 2 3
17 (d) I felt I wasn't worth much as a person	0 1 2 3
18 (s) I felt that I was rather touchy	0 1 2 3
19 (a) I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	0 1 2 3
20 (a) I felt scared without any good reason	0 1 2 3
21 (d) I felt that life was meaningless	0 1 2 3

APPENDIX F

Institutional Research Board (IRB) Approval

INSTITUTIONAL REVIEW BOARD
OFFICE OF RESEARCH INTEGRITY

DATE:	September 29, 2022
TO:	Katie Moskal, BS
FROM:	Western Kentucky University (WKU) IRB
PROJECT TITLE:	[1968054-1] Emerging Adult Health Behaviors Survey
REFERENCE #:	IRB 23-067
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	September 29, 2022
REVIEW TYPE:	Exempt Review

Thank you for your submission of New Project materials for this project. The Western Kentucky University (WKU) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Exempt Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by an *implied* consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a MINIMAL RISK project.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Robin Pyles at (270) 745-3360 or Robin.Pyles@wku.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Western Kentucky University (WKU) IRB's records.

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