The Association Among COVID-19 Anxiety, Drinking to Cope, Alcohol Self-Medication and Alcohol Use in Young Adults: A Cross-Sectional Descriptive Study

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CHAPTER 1

INTRODUCTION

Statement of Problem

Binge drinking is form of high-risk drinking and is a key policy and public health issue in the United States because it is the most common, costly, and deadly pattern of excessive alcohol intake (Centers for Disease Control and Prevention, 2019). Binge drinking rates are highest among college and noncollege attending young adults. Binge drinking among young adult populations (18 to 30 years) continues to be associated with unacceptable morbidity and mortality rates (Centers for Disease Control and Prevention, 2021). This is exemplified by the number of emergency room visits, hospitalizations and increased health care costs associated with binge drinking episodes. In 2018, 34.9% of young adults (18 to 25 years) reported binge drinking in the past month and 9% of young adults reported binge drinking ≥ 5 days in the past month (Substance Abuse and Mental Health Services Administration, 2019). Defined by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) as consuming five or more drinks for males and four or more drinks for females in 2 hours, binge drinking poses significant health risks to young adults (U.S. Department of Health and Human Services, 2021). In addition to costing the United States nearly $192 billion annually, every year college student alcohol use is associated with 646,000 physical assaults, 97,000 sexual assaults, 599,000 unintentional injuries, and 1,825 deaths (Merrill & Carey, 2016; Patrick et al., 2017; A. White & Hingson, 2013). Although there are differences among the results from national alcohol use surveys, findings from the majority of surveys indicate an increase in the prevalence of binge drinking (e.g., using data from the National Epidemiologic Survey on Alcohol and Related Conditions, Grant et al.

(2017) reported a 38% increase in the estimated 10-year prevalence of binge drinking between 2002-2013 among adults (≥ 18 years). A 2018 meta analysis of epidemiologic surveys of adult (≥ 18 years) from 2000 to 2016 highlighted the differences among alcohol use surveys, but did not find a significant increase in alcohol use in adults 18 to 29 years. Nonetheless, this meta analysis identified that the prevelance of binge drinking in the young adult population remained unacceptably high (Grucza et al., 2018).

The reasons for the high rates of binge drinking among young adults are more than likely multifactorial. The "self-medication" hypothesis however, has been proposed as one explanation for ongoing high rates of binge drinking among young adults. This hypothesis states alcohol consumption may be used to alleviate, cope with, or improve feelings after experiencing negative events or emotions (Dyer et al., 2019; Khantzian, 1985; Kuntsche et al., 2017). Negative emotions can include distress and feelings of tense and anxious states. In the most recent Healthy Minds study, nearly one third (31%) of surveyed students screened positive for an anxiety symptoms on the General Anxiety Disorder-7 (GAD-7; Eisenberg & Lipson, 2014). Currently, approximately 11–12% of college students meet the DSM-V criteria for mood and anxiety disorders with rates of generalized anxiety and social anxiety increasing over the past 10 years (2000 – 2019) (Locke, 2019; Merrill & Carey, 2016). Since the global outbreak of the Coronavirus disease of 2019 (COVID-19), there are multiple reports of increased depression and anxiety symptoms among different populations and age groups (Czeisler et al., 2020; Ettman et al., 2020; Salari et al., 2020). Hawes et al. (2021) found a significant increase in anxiety disorder symptoms (i.e., generalized anxiety and social anxiety) among adolescents and young adults residing in Long Island, New York, one of the epicenters of the pandemic. There is also emerging evidence that during the pandemic individuals have increased their alcohol use to cope

with psychological distress which coincides with an increase in alcohol sales in the United States (e.g., 21% and 234% increase in 'in-store' and online alcohol beverage sales; NielsenIQ, 2020; Rodriguez et al., 2020). Given the increasing rates of anxiety disorders among young adults and self-medication of anxiety symptoms which may include COVID-19 anxiety, it is important to determine if there is an association between binge drinking, anxiety and motives for alcohol use (frequency and intensity).

Long-Term Goal and Purpose of the Study

Our long-term goal is to understand factors associated with binge drinking in young adults and ultimately decrease young adult binge drinking and hazardous drinking rates by developing interventions that target the unique stressors that impact their binge drinking behaviors. The purpose of this study is to determine the associations of anxiety, COVID-19 anxiety, drinking to cope with anxiety, alcohol self-medication, and alcohol use (quantity and frequency measures that reflect a binge pattern of drinking) among young adults.

Research Questions or Hypotheses

Specific Aim #1: To determine the association of anxiety with alcohol use (frequency and intensity) in young adults ages 18 to 30 years. *Hypothesis 1a:* In young adults, higher scores on the PROMIS Anxiety Scale will be positively associated with Alcohol Use Disorders Identification Test (AUDIT) and AUDIT-C scores and Alcohol Intake Questionnaire (AIQ)-derived binge drinking frequency and intensity questions. *Hypothesis 1b:* Higher scores on the CAS will be positively associated with AUDIT and AUDIT-C scores and AIQ binge drinking frequency and intensity scores in young adults.

Specific Aim #2: To examine the mediational effect of drinking to cope with anxiety on the association of anxiety with alcohol use (frequency and intensity) in young adults ages

18 to 30 years. *Hypothesis 2a:* The Modified Drinking Motives Questionnaire – Revised coping subscale score will mediate the relationship between the PROMIS Anxiety scale score and the AUDIT score. *Hypothesis 2b:* The Modified Drinking Motives Questionnaire - Revised coping subscale score will mediate the relationship of the Coronavirus Anxiety Scale score with the AUDIT score.

Specific Aim #3: To examine the mediational effect of alcohol self-medication on the association of anxiety with alcohol use (frequency and intensity) in young adults ages 18 to 30 years. *Hypothesis 3a:* Self-report of alcohol self-medication will mediate the relationship between PROMIS Anxiety score and AUDIT score. *Hypothesis 3b:* Self-report of alcohol self-medication will mediate the relationship between Coronavirus Anxiety Scale score and AUDIT score.

Significance of the Issue and Need for Study

Frequency of Young Adult Binge Drinking

In the 2018 National Survey on Drug Use and Health, 55.1% of young adults ages 18 to 25 years (18.8 million individuals) were current alcohol users (Substance Abuse and Mental Health Services Administration, 2019). In the same year, 34.9% of young adults ages 18 to 25 years reported binge drinking in the past month and 9% reported binge drinking on 5 or more days in the past month (Substance Abuse and Mental Health Services Administration, 2019). This increased from 2015, when 17.1% of adults 18 years and older in the United States reported binge drinking about once per week (States et al., 2020). In 2015, it was estimated 73% of men and 53% of women reported at least one binge drinking occasion in the past year (Kuntsche et al., 2017). The World Health Organization projects alcohol consumption will continue to

increase in the United States through at least 2025, raising concern that rates of binge drinking among young adults in the United States will continue to rise (E. Schulenberg et al., 2018).

Although binge drinking is defined as consuming five or more drinks for males and four or more drinks for females in 2 hours, many young adults consume even greater quantities of alcohol during a binge drinking episode. In 2015, young adults reported consuming an average of seven drinks per binge drinking episode (States et al., 2020). In the 2018 Monitoring the Future Survey, 8.4% respondents reported extreme binge drinking, defined as having 10 or more drinks on at least one occasion in the last 2 weeks, and 3.4% of respondents reported having more than 15 drinks on one occasion in the past 2 weeks (Schulenberg et al., 2019).

Binge drinking has increased more rapidly among women than men in recent decades (Patrick et al., 2017). Women currently report greater lifetime largest number of drinks consumed in one sitting and greater frequency of binge drinking than they have in the past (Delker et al., 2016). Further research evaluating the rise in binge drinking among young adult women is warranted at this time.

Health Consequences of Young Adult Binge Drinking

Young adult binge drinking poses significant threats to public health in the United States. Every year, excessive alcohol consumption accounts for 1 in 10 deaths among adults aged 20 to 64 years in the United States (States et al., 2020). In 2010, alcohol was the leading risk factor for worldwide mortality and disease burden for individuals ages 15 to 49 years (Patrick et al., 2017). In over half of the alcohol-attributable deaths in the United States from 2006 to 2010, the individual responsible had a blood alcohol concentration (BAC) greater than 0.08g/dL (Patrick et al., 2018). Hospitalizations for alcohol overdose among individuals ages 18 to 24 years have also increased from 78.42 per 100,000 young adults ages 18 to 24 in 1999 to 97.75 per 100,000 in

2008, reflecting a 25% increase from 1999 to 2008, raising concern that without medical intervention, mortality from excessive alcohol use would be greater (A. M. White et al., 2011).

Intoxication can result in hangovers, blackouts, memory loss, nausea, vomiting, and alcohol overdose, which can result in death (Kuntsche et al., 2017). Alcohol abuse can also result in alcoholic liver disease, which is on the rise in the United States. The death rate from alcoholic liver disease increased over 40% from 4.1 per 100,000 in 2006 to 5.9 per 100,000 in 2016 (Grucza et al., 2018). Rates of myocardial infarction are also on the rise among young adults that cannot be attributed to cardiovascular risk factors such as hypertension, dyslipidemia, or diabetes (Yang et al., 2019). An analysis of eight consecutive National Health and Nutrition Examination Survey (NHANES) from 1999–2000 to 2013–2014 (n = 18,803) found the adjusted prevalence of having these three risk factors declined from 21.8% to 18.9% over this time period (Leppert et al., 2019). Increase in myocardial infarction has been attributed to substance abuse, including alcohol abuse, among young adults demonstrating the significant cardiovascular risk of young adult binge drinking (Leppert et al., 2019).

Young adult binge drinking is associated with increased risky sexual behavior, including engaging in unplanned and unprotected sex (Kuntsche et al., 2017; Merrill & Carey, 2016; National Institute on Alcohol Abuse and Alcoholism, 2019). Twenty-one percent of college students reported unplanned sexual activity while drinking and 10% reported unprotected sex while drinking (Merrill & Carey, 2016). One study found intention to engage in unprotected sex increased by 5% with a 0.1g/mL rise in BAC (Kuntsche et al., 2017). This is particularly concerning in light of the increased potential for sexual assault with binge drinking. The 2005 Core Alcohol and Drug Survey found 82% of students who experienced unwanted sexual intercourse were intoxicated at the time (A. White & Hingson, 2013). These findings were

replicated in a 2009 study that found 20% of college females experience some form of sexual assault while on campus (A. White & Hingson, 2013).

Binge drinking also poses significant threats to young adults' mental health. There was a 50% increase in the prevalence of DSM-IV alcohol use disorder diagnoses in individuals 18 years and older from the 2001–2002 National Epidemiological Survey on Alcohol and Related Conditions (NESARC) survey to the 2012–2013 NESARC survey (Grucza et al., 2018). Binge drinkers have reported higher on measures of anxiety and depression, and frequent binge drinkers have been twice as likely as infrequent binge drinkers to experience blackouts (binge drinking was defined by how often in the previous 12 months participants consumed more than X amount of alcohol with separate doses, equivalent to: ≥ 10 g, ≥ 40 g, ≥ 60 g, ≥ 100 g, ≥ 140 g and ≥ 180 g of pure ethanol; Bell et al., 2014; Krieger et al., 2018; Nourse et al., 2017). College students who reported binge drinking (defined as having five (male)/four (female) drinks in a row in the past 2 weeks) in the past 12 months were also more than twice as likely to report having serious thoughts of suicide (Cranford et al., 2006; Krieger et al., 2018). NIAAA estimated 1.2–1.5% of college students who attempt suicide have substance abuse problems, which is particularly alarming since suicide is the second leading cause of death among college students (Nourse et al., 2017; A. White & Hingson, 2013). Furthermore, about one half of students who meet alcohol use disorder criteria at age 19 continue to meet this criteria at age 25, suggesting risky drinking patterns in young adulthood may increase the risk of future alcohol use disorders (Merrill & Carey, 2016)

The significant health consequences of young adult binge drinking are exacerbated by the substantial neurobiological development that occurs during this period. Alcohol use during young adulthood can impair neural development and cognitive functioning (Cservenka &

Brumback, 2017; Lees et al., 2019). A review of cross-sectional and longitudinal functional magnetic resonance imaging (fMRI) studies of young binge and heavy drinkers found binge drinking among youth is associated with thinner cortical and subcortical structures, and decreased white matter integrity (Cservenka & Brumback, 2017). The fMRI studies included in the review also found young adults who engage in binge drinking and heavy drinking exhibit greater reliance on front-parietal systems during working memory, cognitive control, and verbal learning tasks than their peers, which may have significant impact on their future cognitive function (Cservenka & Brumback, 2017).

Social Consequences of Young Adult Binge Drinking

In addition to the morbidity and mortality associated with young adult binge drinking, frequent binge drinking has been associated with numerous social consequences. For example, young adult binge drinking has been associated with college students missing class, young adults driving after drinking, academic failure, injury, and legal complications (Kuntsche et al., 2017; Merrill & Carey, 2016; National Institute on Alcohol Abuse and Alcoholism, 2019). Together, excessive drinking cost the United States $249 billion; 77% of this total cost was attributable to binge drinking (Patrick et al., 2018).

In response to the significant risks associated with young adult binge drinking, in 2002 the NIAAA Task Force on College Drinking released a report, *A Call to Action: Changing the Culture of Drinking at U.S. Colleges*, outlining the current state of alcohol misuse on college campuses and calling for improved prevention strategies (National Institute on Alcohol Abuse and Alcoholism, 2019). In this study we focused on answering this call and improve the health of young adults by identifying areas for future binge drinking prevention strategies.

College Student Alcohol Use

Numerous factors have been associated with increased heavy drinking and alcohol-related problems among young adults. One of the most widely cited risks for young adult alcohol use is college attendance. In a study of the data from the 2012–2013 NIAAA National Epidemiological Survey on Alcohol and Related Conditions-III using latent class modeling of drinking frequency (n = 2,213), college student status was significantly associated with drinking class (occasional, light drinkers; regular drinkers with occasional binging; frequent drinkers with occasional binging; high-intensity drinkers; -2 log L = 24.71, 4 df, $p < .001$; Linden-Carmichael, 2018). Four-year college students also reported higher odds of drinking 5+, 10+, and 15+ drinks compared to nonattenders and 2-year college students when controlling gender, race, parental education, cohort, alcohol use initiation, heavy and high intensity drinking at age 18, age, and living with parents (Patrick & Terry-McElrath, 2017). Results from this study are summarized in Table 1. It was hypothesized binge drinking is greater among college students than their noncollege-attending peers because of a combination of leaving home, being with peers most of the day, engagement in organizations that promote alcohol use such as Greek organizations, and approaching the legal drinking age of 21 years (Kuntsche et al., 2017).

Table 1

Summary of Patrick and Terry-McElrath (2017) Results

Number of Drinks	Not attending college		Part-time college		2-year full-time college		4-year full time college
	AOR**	95% confidence interval	AOR**	95% confidence interval	AOR**	95% confidence interval	AOR**, 95% CI
5+	0.57*	.44 – .75	0.85	.60 – 1.22	0.56*	.41 – .77	(ref)
10+	0.52*	.36 – .76	0.92	.57 – 1.49	0.66*	.48 – .91	(ref)
15+	0.42	.24 – .75	0.81	.40 – 1.68	0.53	.33 – .85	(ref)

Note. Adapted from "High-Intensity Drinking by Underage Young Adults in the United States," by M. Patrick & Y. Terry-McElrath, 2017, *Physiology & Behavior*, *112*(1), 82–93. https://doi.org/10.1016/j.physbeh.2017.03.040

*$p < .05$; **AOR: Adjusted odds ratio

An emerging explanation for college student alcohol use and binge drinking is the rising rates of mental health conditions. In the 2019 Center for College Mental Health Annual Report, which included data from 163 college and university counseling centers describing 207,818 students seeking mental health treatment, approximately one of every three students screened positive for a current mental health condition (as defined by the Counseling Center Assessment of Psychological Symptoms – 64 (Locke, 2019). In the report it was estimated 20–35% of college students need mental health treatment in a given year, and although rates of depression (+0.22), generalized anxiety (+0.25), and social anxiety (+0.24) have risen over the past 10 years (as evidenced by reported Counseling Center Assessment of Psychological Symptoms scores), the national rate of counseling center use is only 11.8% (Locke, 2019). Nourse et al. (2017) estimated only 4–5% of students with problematic alcohol use patterns and only 36–38% of students with anxiety and depression symptoms seek counseling and treatment.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Theoretical Framework

We used Cox and Klinger's (1988) motivation model of alcohol use to guide this study. This model was founded on the idea the final common pathway to alcohol use is motivational. Cox and Klinger stated people make the decision to drink or not to drink alcohol. This decision is based on a combination of emotional and cognitive processes, though the person is not always aware of how these processes impact their decision to drink or not to drink.

The first of these processes outlined in the motivational model of alcohol use are "historical factors," which include individuals' previous experiences with alcohol that impact their current motivation to drink. Historical factors include: (a) their biochemical reactivity to alcohol (i.e., how they metabolize alcohol and its byproducts and their development of tolerance to alcohol); (b) their personality (including characteristics such as nonconformity, impulsivity, and reward seeking); (c) sociocultural/environmental influences (including cultural drinking practices; family, friend, and peer alcohol use, and social rewards for drinking or not drinking); (d) past reinforcement for drinking (i.e., individuals who have experienced strong reinforcement for drinking alcohol are more likely to habitually consume alcohol in the future); and (e) conditioned reaction to alcohol (i.e., individual's classically conditioned emotional responses to drinking alcohol and stimuli associated with alcohol consumption; Cox & Klinger, 1988).

The motivational model of alcohol use also identified "current factors" that influence an individual's motivation for drinking. Current factors include current situational factors and current positive and negative incentives. Situational factors are defined as an individual's

immediate environment when they make the decision to drink or not to drink, including physical setting and the individuals a person is with (if any) when they make the decision. Positive and negative incentives are defined as the current benefits to drinking alcohol and the current drawbacks to alcohol consumption at the time of the decision (Cox & Klinger, 1988).

In the motivational model of alcohol use, Cox and Klinger state that historical factors and current factors will bring about "cognitive mediating events," which determine an individual's expectations about the direct (i.e., chemical) and indirect effects (i.e., enhancing or reducing positive affect; enhancing or reducing negative affect) of alcohol consumption (Cox & Klinger, 1988). Cox and Klinger (1988) differentiated expectancy and motivation and stated, "Expectancies are people's beliefs about what will happening if they (or other people) drink alcohol, whereas motives are the value placed on the particular effects they want to achieve, which motivate them to drink" (Cox & Klinger, 2004, p. 124). Otherwise stated, an individual's expectations about the effects of alcohol does not inherently imply he or she will drink alcohol (Kuntsche et al., 2010).

Drinking motives are classified on two dimensions: (a) valence (positive or negative), and (b) the source of the outcomes expected from drinking alcohol (internal or external; Kuntsche et al., 2010). This results in four drinking motive categories:

> a) internally generated, positive reinforcement motives (drinking to enhance positive mood); b) externally generated, positive reinforcement motives (drinking to obtain social rewards); c) internally generated, negative reinforcement motives (drinking to reduce negative emotions); and d) externally generated, negative reinforcement motives (drinking to avoid social rejection). (Kuntsche et al., 2010, p. 437)

In our study we focused on the negative reinforcement motives, specifically focusing on drinking to cope with anxiety.

Rigor of Prior Research: Strengths and Weaknesses of Supporting Data

Anxiety and Alcohol Use

To date, there has been limited evidence for the association between anxiety and binge drinking. While several studies found a positive relationship between increased anxiety and binge drinking, few studies evaluate the relationship between *young adult* anxiety and binge drinking. Instead, most studies include all adults ages 18 years and older in their analyses.

In a 2020 representative study of Singapore residents ages 18 years and older (n = 6,126, mean age not reported), binge drinking (defined as 5+/4+ drinks in 2 hours in the past 12 months) was associated with an increase in generalized anxiety disorder (aOR_{female} = 3.3, 95% CI_{female} 1.0–10.4; aOR_{male} = 2.5, 95% CI_{male} 1.0–6.4) and obsessive compulsive disorder (aOR_{female} = 2.3, 95% CI_{female} 1.1–4.9; aOR_{male} = 1.2, 95% CI_{male} 0.5–2.6; Y. Y. Lee et al., 2020). Acknowledging drinking patterns are variable by age and peak in young adulthood, studies of the general population have not investigated the unique impact of anxiety on binge drinking in a young adult population.

Findings from studies examining the relationship between anxiety and binge drinking in young adults are inconsistent. In a 2005 study using NESARC data (n = 43,093, age range: 18–29 years), individuals with agoraphobia (aOR = 0.6, 95% CI 0.2–1.8), social phobia (aOR = .7, 95% CI 0.2–2.3), and generalized anxiety (aOR = 0.5, 95% CI 0.2–1.7) reported decreased binge drinking (defined as 5+ drinks per men and 4+ drinks for women in the past year); whereas, individuals with specific phobias reported increased binge drinking (aOR = 1.3, 95% CI 0.8–2.4; Dawson et al., 2005). Similarly, in a 2009 cross-sectional study exploring the association

between substance use behaviors and mental health problems among college students (n = 274), panic disorder (OR = 1.1, 95% CI 0.8–1.4) and generalized anxiety disorder (OR = 1.4, 95% CI 0.9–2.3) were associated with increased binge drinking (defined as 5+ drinks for men, 4+ drinks for women in past 2 weeks; Cranford et al., 2009). In a 2018 cross-sectional study of college students (N = 171), binge drinking (measured using the CORE Alcohol and Drug Survey items) was positively correlated with Beck Anxiety Inventory score (r = .022, p < .05; Wemm et al., 2018). Another 2018 cross-sectional study of college students (N = 526), using the same methods as the previously reported study also found binge drinking (defined as 5+ drinks in the past 2 weeks) was positively correlated with Beck Anxiety Inventory score (r = .110, p < .05; Wemm et al., 2018). Conversely, in a 2015 analysis of Survey of Lifestyle, Attitude and Nutrition (SLAN) participants ages 18 to 29 years (n = 2,590), individuals who reported increased anxiety were 20% less likely to report binge drinking (dichotomous measure based on AUDIT-C score; OR = 0.8, 95% CI 0.52–1.3; Mohamed & Ajmal, 2015).

The disparity in findings was highlighted by a 2019 systematic review of the impact of anxiety disorders on future alcohol use and alcohol use disorders. In this review, 33% of studies found a positive association between anxiety disorders and later alcohol use, 18% of studies found a negative association, 26% found equivocal associations, and 24% reported "unclassifiable" associations (Dyer et al., 2019). Although this systematic review did not focus on young adult binge drinking exclusively, the significant differences noted by the authors raised concern that further investigation of the impact of anxiety on young adult binge drinking may be warranted to adequately describe the relationship between these two concepts (Dyer et al., 2019).

One possible reason for the disparities noted in Dyer et al.'s (2019) systematic review may be a result of the variability in measures used by the reviewed studies. Studies that have

evaluated the relationship between anxiety and alcohol use among young adults have methodological concerns, such as a failure to use validated instruments to measure the key concepts of anxiety and binge drinking. In a 2016 longitudinal study of young adults in Norway (n = 2,171, mean age Time 1 = 14.9 years), which found a weak positive impact of change in anxiety on heavy episodic drinking (defined as the number of times drank to the point of intoxication in the past 12 months) over time (standard error of the estimate = 3.65, SE = 0.74, p < .001), heavy episodic drinking was measured with a single, unvalidated survey item and anxiety was measured with three items from the Hopkins Symptoms Checklist (Pape & Norström, 2016). Recognizing the Hopkins Symptom Checklist anxiety subscale consists of 10 items, not three as used in this study, there has been concern whether or not the researchers accurately measured the key concepts (Derogatis et al., 1974).

Another methodological weakness of existing studies is the cross-sectional design of studies, which prevents the conclusion of causal relationships. In a 2017 study of the association of binge drinking (measured using the AUDIT) with anxiety (n = 201), 36.3% of college students reported they experienced anxiety problems before they started drinking alcohol (Nourse et al., 2017). Although the relationship was not statistically significant, the study found a positive association between anxiety symptoms (measured by GAD-7) and AUDIT scores (r = -.03, p = .68; Nourse et al., 2017). While initially it may appear anxiety symptoms caused college students to binge drink, because this was a cross-sectional design, no such conclusion can be drawn. Future research would benefit from using longitudinal designs to further clarify the nature of the association between anxiety and young adult binge drinking.

The external validity of current studies is an additional weakness of existing studies. For example, in a 2018 cross-sectional study of the relationship among anxiety and alcohol

consumption (defined as 5+ drinks on one occasion in the past 12 months) and alcohol-related problems in college students (n = 1,254), only first semester college students were included in the study (Kenney et al., 2018). This raised concern these findings may not be representative of their noncollege-attending peers and older young adults (Kenney et al., 2018). Similarly, in a 2017 cross-sectional study of the relationship between anxiety, depression, and binge drinking (measured using the AUDIT) among college students (n = 201), which found no statistically significant relationship between anxiety score (r = -0.03, p = .68) and hazardous alcohol consumption, participants were 84% White, 74.6% female, and students at a small private college in the northeast United States (Nourse et al., 2017). This raised concern these findings may not be representative of their noncollege-attending peers, older young adults, and young adults living in other geographic areas.

COVID-19 Anxiety and Alcohol Use

The impact of anxiety on binge drinking is of particular interest in light of the COVID-19 pandemic. Recent marketing research has shown between March 1, 2020 and April 18, 2020, alcohol sales have risen 21% in person and 234% online in the United States, raising concern that alcohol consumption, including binge drinking, has also increased during this time (NielsenIQ, 2020). What remains unknown, however, is why alcohol consumption has increased. One possible explanation for increased alcohol consumption during this time is drinking to cope with COVID-19 related anxiety.

In an April 2020 study conducted in India (n = 354, 88.4% of participants ages 18 to 30 years), individuals who reported anxiety (measured by the Depression Anxiety Stress Scale-21 anxiety subscale) were significantly more likely to report binge drinking (defined as drinking 4+ drinks for females and 5+ drinks in an occasion in the past 30 days; OR = 2.62, CI 1.36–5.0, p

< .05; Verma & Mishra, 2020). The authors did not evaluate, however, if individuals were binge drinking to cope with their anxiety, or if their anxiety was a result of the COVID-19 pandemic (Verma & Mishra, 2020). Similarly, in an April 2020 survey of adults (≥ 18 years) in the United States (n = 754, mean age = 41.7 years), COVID-19 stressors (measured by the Perceived Coronavirus Threat Questionnaire – Short version) were associated with greater maximum number of drinks consumed (R^2 = 1.07, z = 3.66, p < .001), drinks consumed on a typical occasion (R^2 = 1.08, z = 4.06, p < .001), and number of drinking days in the past month (R^2 = 1.08, z = 3.72, p < .001; Rodriguez et al., 2020). The authors, however, failed to evaluate the association between COVID-19 anxiety and binge drinking specifically. Additionally, the mean age of participants in this study was 41.7 years, suggesting these findings may not be representative of a young adult population (Rodriguez et al., 2020).

In an August 2020 British study on the impact of COVID-19 related stress factors on alcohol consumption (N = 1346, mean age = 28.92, SD = 10.45), anxiety (measured by the Hospital Anxiety and Depression Scale) was positively associated with alcohol use (measured by the AUDIT-C; r = .12, p = .03; Sallie et al., 2020). Similarly, a May 2020 study of college students at a large public university in northeast Ohio (N = 1,958, mean age = 24.94, SD = 7.65) found anxiety (measured by the GAD-7) was positively associated with alcohol use (measured by the 2-week TLFB; β = .026, p < .001; Lechner et al., 2020). In both studies, however, the authors failed to evaluate why participants were consuming more alcohol, raising question about the motive for increased alcohol use during the COVID-19 pandemic.

Conversely, several studies did not find a positive association between anxiety and alcohol use during the COVID-19 pandemic. A 2020 Australian study (N = 4462, 9.2% participants between ages 18 to 24 years) on the impact of distal and proximal risk factors on

alcohol use (measured by a single ordinal item) during the COVID-19 pandemic found anxiety (measured by the Depression, Anxiety, and Stress Scale) was not associated with increased drinking (defined using single item "In the past week, have there been any changes to the amount you are drinking?"; β = -0.01, p = .44; Neill et al., 2020). Similarly, a January 2021 British study of the impact of COVID-19 on alcohol consumption (N = 691, 33% of participants ages 18 to 34 years), anxiety (measured by the Beck Anxiety Inventory) was not significantly associated with increased alcohol consumption since the COVID-19 pandemic (measured by single survey item; β = 1.51, p = .18; Jacob et al., 2021). As a result, further research was required to clarify the relationship between anxiety and alcohol use during the COVID-19 pandemic. Furthermore, additional research was required to evaluate the association between COVID-19-specific anxiety and alcohol use as studies thus far have evaluated the impact of generalized anxiety and anxiety symptoms on alcohol use.

Drinking Motives

The primary weakness of existing literature is it fails to examine the relationship between young adults' drinking motives and binge drinking. To date, there has been strong evidence demonstrating drinking to cope is associated with increased alcohol use frequency and quantity, but there is limited evidence on the association between young adult drinking motives and binge drinking specifically.

In a 2017 cross-sectional study using path analysis and two independent samples to examine the effect of drinking motives (measured using the MDMQ-R) on the association between anxiety (measured using the Penn State Worry Questionnaire) and depression (measured using the CESD-R) and alcohol-related problems (measured using the Brief-Young Adult Alcohol Consequences Questionnaire; n_1 = 204, mean age$_1$ = 21.24, SD_1 = 5.46; n_2 = 313,

mean age_2 = 20.11, SD_2 = 3.67), both anxiety and depressive symptoms had indirect effects on alcohol-related problems via drinking to cope with anxiety motives ($\beta_{sample1}$ = 0.038, $\beta_{sample2}$ = 0.012; Bravo & Pearson, 2017). Similarly, in a 2016 5-week longitudinal study examining the interactions between drinking motives, drinking group size, and young adults' (*M* = 23.1, *SD* = 3.1, *n* = 276) event-level hourly alcohol consumption rate, there was a positive association between Drinking Motives Questionnaire score and hourly alcohol consumption rate slope (*r* = 0.050, *p* = .066; Thrul & Kuntsche, 2016). In a 2016 cross-sectional study examining the associations between posttraumatic stress disorder (PTSD) symptoms, anxiety sensitivity, and motives for alcohol use among college students with reported lifetime interpersonal trauma and alcohol use (*n* = 295), drinking to cope increased alcohol use frequency in the past 30 days (β = .284, *p* <.001), and alcohol use quantity in the past 30 days (β = .036, *p* = .479; Berenz et al., 2016). Finally, in a 2006 study examining the relationship between social anxiety and problematic alcohol use (*n* = 293, mean age = 20.4, *SD* = 2.9), coping with unpleasant emotions was associated with alcohol-related problems (measured by the Rutgers Alcohol Problems Index; β = 0.53, *p* <.01; Buckner et al., 2006). These studies, however, fail to examine the relationship between drinking to cope and binge drinking which is a distinct pattern of alcohol consumption that places young adults at significant risk.

Studies that have evaluated the relationship between young adult binge drinking and young adult drinking motives have methodological weaknesses. The primary weakness of this literature is the majority of studies examining the relationship between drinking to cope with anxiety and young adult alcohol use have used the four-factor Drinking Motives Questionnaire – Revised (DMQ-R) rather than the 5-factor Modified Drinking Motives Questionnaire – Revised (MDMQ-R) to measure drinking motives. The primary difference between the DMQ-R and

MDMQ-R is the DMQ-R measures drinking to cope with feelings of depression and anxiety together, while the MDMQ-R has separate coping-depression and coping-anxiety subscales (Bravo & Pearson, 2017; Grant et al., 2007; Nehlin & Öster, 2019).

In a 2018 cross-sectional study of college students (N = 171), binge drinking (defined as 5+ drinks on one occasion in the past 2 weeks) was positively correlated with DMQ-R score (r = .25, p <.01; Wemm et al., 2018). Similarly, in a 2018 cross-sectional study of college students (N = 526), binge drinking (defined as 5+ drinks on one occasion in the past 2 weeks) was positively correlated with DMQ-R score (r = .17, p < .01; Wemm et al., 2018). A 2009 cross-sectional study using structural equation modeling to evaluate the mediating role of motivates on the association between social anxiety and hazardous drinking (measured using the AUDIT; n = 817, mean age = 19.94 years, SD = 2.2), found drinking to cope mediated the relationship between social anxiety and alcohol quantity/frequency (β = .10, p < .05), alcohol negative consequences (β = .20, p < .001), and alcohol dependence symptoms (β = .18, p < .001; Ham et al., 2009). Finally, in a 2009 3-week study examining the moderating effects of drinking motives of in-person daily mood-alcohol use associations among college students (n = 168, mean age not reported), drinking to cope with anxiety predicted average daily drinking (β = .08, p = .55; Grant et al., 2009). By using the DMQ-R rather than the MDMQ-R, however, to measure drinking to cope with anxiety, the validity of these studies decreases as the coping subscale of DMQ-R is capturing drinking to cope with depression rather than, or in addition to, coping with anxiety alone.

Alcohol Self-Medication

Although some studies have found a relationship between anxiety and binge drinking in this population, they have not measured whether or not young adults binge drink to cope with

anxiety as theorized by the self-medication hypothesis. The self-medication hypothesis states the consumption of alcohol may be used to alleviate, cope with, or improve feelings after experiencing negative events or emotions (Dyer et al., 2019; Kuntsche et al., 2017). It is possible alcohol self-medication may mediate the relationship between anxiety and binge drinking; yet, this remains understudied in the literature.

To date, research on alcohol self-medication has primarily used data from two epidemiological surveys, the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) and the National Comorbidity Survey (NCS; Turner et al., 2018). These surveys reported a 10–21.9% prevalence of alcohol self-medication among individuals with anxiety disorders (as defined by the NIAAA Alcohol Use Disorder and Associated Disabilities Interview Schedule – DSM-IV version and a modified version of the World Health Organization Composite International Diagnostic Interview; Social phobia$_{\text{NESARC Wave I}}$: 14.9%; Social phobia$_{\text{NCS}}$: 29.1%; GAD$_{\text{NESARC Wave I}}$: 14.1%; Any anxiety disorder$_{\text{NESARC Wave I}}$: 10.0–20.3% Any anxiety disorder$_{\text{NESARC Wave II}}$: 20.8%; Any anxiety disorder$_{\text{NCS}}$: 21.9%; Turner et al., 2018).

Several studies using longitudinal data from NESARC Waves I and II also found individuals who reported using alcohol to self-medicate drinking at baseline reported increased alcohol dependence at two year follow up (Crum et al., 2013; Menary et al., 2011; J. A. Robinson et al., 2009, 2011). In a 2013 longitudinal study of NESARC participants with anxiety symptoms (n = 1,567) examining the association of self-medication drinking with alcohol dependence, individuals who reported alcohol self-medication of anxiety at baseline reported increased alcohol dependence at two year follow up (OR = 9.96, CI 6.47–15.32; Crum et al., 2013). In a 2011 longitudinal study using Waves I and II of NESARC data (n = 43,093) examining the role of anxiety self-medication with alcohol on the future development of alcohol

use disorders, 12.5% of individuals with anxiety disorders at baseline reported self-medicating with alcohol, and individuals who self-medicated anxiety with alcohol at baseline was associated with an increased risk of alcohol dependence at two year follow up (*AOR* = 2.63, 95% CI 1.04–6.67; J. Robinson et al., 2011).

Similarly, in a 2011 longitudinal study using Wave I and II NESARC data examining the self-medication hypothesis (*n* = 26,946, mean age = 43.3, *SD* = 16.4), 20.3% of individuals who met criteria for a diagnosis of at least one anxiety disorder in the past 12 months (Menary et al., 2011). Alcohol dependence was most prevalent among individuals with anxiety disorders who self-medicated (34.5%) and self-medication increased the risk of alcohol dependence at two year follow up (*AOR* = 2.71, 95% CI 1.74–4.19, $p < .05$; Menary et al., 2011). In a 2009 analysis of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) data (*n* = 8098) individuals with anxiety disorders reported increased self-medication with alcohol (J. M. Bolton et al., 2009). Results from this survey are summarized in Table 2. Sex differences were not explored in this study (J. M. Bolton et al., 2009). Finally, a 2009 analysis of Wave I and II NESARC data (*n* = 43,093) found individuals who self-medicated with alcohol at baseline were also more likely to develop substance use disorders at two year follow up than individuals who did not self-medicate with alcohol (*AOR* = 5.59, CI 5.58–5.61; J. Robinson et al., 2009).

Table 2

Summary of 2009 NESARC Survey Results at Baseline

Anxiety disorder	Men		Women	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Generalized anxiety disorder	1.46	1.05 – 2.03	1.58	1.18 – 2.11
Panic disorder	1.32	0.94 – 1.83	1.26	.98 – 1.62
Social phobia	1.44	1.01 – 2.04	1.22	.91 – 1.63

Specific phobia	1.25	.89 – 1.75	1.10	.86 – 1.42
Any lifetime anxiety disorder	1.46	1.15 – 1.85	1.33	1.07 – 1.66

These studies have numerous limitations. First, these studies used data collected between 1990–1992 (NCS) and 2001–2005 (NESARC), which may no longer be representative of young adult binge drinking in the United States when considering the rapidly changing prevalence of binge drinking and anxiety disorders in this population (J. Bolton et al., 2006; Crum et al., 2013). These studies have also focused on individuals who met diagnostic criteria for DSM-IV anxiety disorders; thereby, failing to capture individuals with subthreshold anxiety symptoms who are also at risk (Turner et al., 2018). Furthermore, diagnostic criteria for anxiety disorders has been updated with the release of the DSM-V, and as a result the reported prevalence of anxiety disorders may no longer reflect current diagnostic standards. Many of the reviewed studies also failed to report alcohol self-medication for young adults specifically, raising concern the findings may not be representative of this population, which is known to have increased rates of binge drinking (Turner et al., 2018).

Similar to the drinking motives literature, there is a lack of data examining the relationship between alcohol self-medication and binge drinking specifically. This is of particular concern when acknowledging not all individuals who binge drink will develop alcohol dependence and alcohol use disorders (as has been the focus of existing alcohol self-medication literature). Existing studies are further limited by their measurement of alcohol self-medication. The single NESARC item used in nearly all of these studies has not been psychometrically validated, and measurement of self-medication is limited to self-report, raising concerns about the validity and reliability of the measurement of this concept. Finally,no study to date assesses the frequency of alcohol self-medication. Recognizing there are likely differences between

individuals who rarely self-medicate their anxiety symptoms with alcohol and those who do regularly, this is a major weakness of existing literature.

Innovation

In our study, were were the first to use validated self-report measures of anxiety, alcohol use, and drinking motives in a young adult population; thereby, overcoming the methodological concerns of previous work. We were also the first study in nearly 15 years to evaluate the relationship among these concepts, providing an updated perspective on the impact of anxiety on young adult binge drinking in light of the rapidly evolving landscape of mental health and substance use disorders in the United States. In our study we were the first to measure the frequency of alcohol self-medication, which may highlight key differences between individuals who frequently engage in alcohol self-medication and individuals who infrequently engage in alcohol self-medication. Finally, in this study we were the first to evaluate the association between COVID-19 anxiety, drinking motives, and binge drinking in a young adult population.

CHAPTER 3

METHODS

Research Design

We used a cross-sectional descriptive design. Participants completed a survey including several measures outlined in this chapter.

Description of Research Setting

This study was conducted at two universities in the Nashville, Tennessee area and included a private, midsized university with a total enrollment of 6,886 undergraduate and 6,245 graduate students and a public historically Black university with a total enrollment of 6,121 undergraduate students and 1,653 graduate students (U.S. News & World Report, 2017; Vanderbilt University, 2020). The PI also recruited participants from throughout the United States using a social media recruitment technique.

Sample and Sampling Plan

Nature and Size of Sample

We used a convenience sample of men and women in this study.

Criteria for Sample Selection, Criteria for Inclusion and Exclusion

Inclusion criteria: Men and women between 18 to 30 years were eligible for study participation.

Exclusion criteria: Individuals were excluded for self-report of past treatment for drug or alcohol use or current medical treatment for psychiatric disorders.

Methods for Subject Recruitment

Participants were recruited from two universities in Nashville, Tennessee. First, the principal investigator contacted the board members of graduate and undergraduate listservs (e.g., Greek life organizations, graduate school newsletters) to request information about the study be sent to their members. Interested individuals then contacted the principal investigator at which time they were given a link to the RedCap survey, which included further information about the study and the survey instruments.

Participants were also recruited using social media. There are emerging data demonstrating the feasibility of the use of social media, particularly Facebook ads and Instagram ads, to recruit young adults including young adult binge drinkers (Ash et al., 2019; Fazzino et al., 2015; Ford et al., 2019; Park & Calamaro, 2013; Ramo et al., 2014; Whitaker et al., 2017; Wisk et al., 2019). Facebook and Instagram ads were purchased targeting young adults ages 18 to 30 years at Vanderbilt University and Tennessee State University. The PI mixed and matched headlines, ad text, and descriptions, and similar pictures were switched in and out to keep advertisements fresh and promote engagement. Potential participants were asked to click on the ad, which linked to the RedCap survey.

All study participants were entered into a raffle for a $200 Amazon gift card to thank them for their time, and one participant was chosen at random to receive the gift card after study enrollment was completed.

Strategies to Ensure Human Subjects Protection

Potential Risks

The primary risk of this study was participant psychological discomfort. The study required participants to discuss their symptoms of anxiety and their alcohol consumption, both of

which may make participants uncomfortable and cause distress. The study also had the potential to reveal participants' underlying anxiety disorders and alcohol use disorders. Acknowledging this potential, at the end of the RedCap survey all participants were presented with contact information for outpatient and emergency psychiatry and drug and alcohol use treatment options in the Nashville, Tennessee area.

Human Subject Protection and Informed Consent

Approval from the Vanderbilt University Institutional Review Board (IRB) was acquired prior to study initiation. The study was deemed to be exempt by the Vanderbilt IRB. Participants were provided further information about the study on the first page of the survey to allow them the opportunity to make an informed decision to complete the study. Participant data were stored in the secured Vanderbilt RedCap data management system to ensure participants' privacy.

Methods

Procedures

Men and women were enrolled from college campuses in the Nashville, Tennessee area and via social media recruitment. To ensure an adequate number of participants completed the study for statistical analysis, the study aimed to recruit 175 participants to account for attrition, and actually recruited 203 with a final analysis of 182. After ensuring participants met inclusion criteria using two RedCap items that triggered the survey to end if they did not, participants were provided further information about the study on the first page of the survey to allow them the opportunity to make an informed decision to complete the study. Participants then completed a demographics questionnaire, the Modified Drinking Motive Questionnaire – Revised, the Patient-Reported Outcomes Measurement Information System (PROMIS) Bank v1.0 – Anxiety, the Coronavirus Anxiety Scale, two alcohol self-medication items, and three alcohol

questionnaires (Timeline Follow Back, Alcohol Intake Questionnaire, AUDIT) via RedCap survey. Participants completed the RedCap survey on their personal smartphone, tablet, or computer.

Measures

The operational definitions of study terms are summarized in Table 3.

Table 3

Operational Definition of Terms

Term	Definition
Alcohol self-medication	The consumption of alcohol to alleviate, cope with, or improve feelings after experiencing negative events or emotions (Dyer et al., 2019; Kuntsche et al., 2017).
Anxiety	"An emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure" (American Psychological Association, 2020).
Binge drinking	"A pattern of drinking that brings blood alcohol concentration (BAC) levels to 0.08 g/dL. This typically occurs after four drinks for women and five drinks for men—in about 2 hours" (NIAAA, n.d.).
Drinking to cope	"The final decision whether to drink or not to drink… to reduce negative emotions" (Kuntsche et al., 2006, pp. 1–2).
Young adult	An individual between the age of 18 to 30 years (Stone et al., 2012).

Demographics: Participants completed a demographic questionnaire including sociodemographic data such as age, sex, ethnicity, and number of school years completed.

Modified Drinking Motives Questionnaire-Revised (MDMQ-R): The MDMQ-R is a 28 item instrument measuring five motivations for drinking alcohol: (a) enhancement (to improve positive mood), (b) coping-anxiety (to relieve symptoms of anxiety), (c) coping-depression (to relieve symptoms of negative mood), (d) social (to obtain social benefits), and (e) conformity (to avoid social rejection) on a 5-point Likert scale (1 = *almost/never* to 5 = *almost/always*; Grant et al., 2007). Permission was obtained from Grant et al. (2007) to use this measure. The 5-factor structure of this instrument was confirmed using confirmatory factor analysis in a study of

Canadian university students ($\chi^2_{(340, N = 726)} = 1299.70$, $p < .001$; Grant et al., 2007). The MDMQ-R also demonstrated acceptable internal consistency ($\alpha = .81$; Villarosa et al., 2014). Cronbach's α was .822 in the present study. The anxiety subscale items were averaged to determine the score for each subscale. Comparable to what was found in the prior work, the anxiety subscale Cronabach's α was .82. Items 2, 8, 11, and 19 were required in the RedCap survey to ensure a key study variable of coping-anxiety score was obtained for each participant.

NESARC Self-Medication Item: The NESARC survey item "Did you EVER drink alcohol to calm down or to help calm down or quiet your nerves when you felt tense, nervous or worried?" was used to assess alcohol self-medication. An additional question, "When you drink alcohol, what percent of the time do you do so in order to calm down or to help calm down or quiet your nerves when you felt tense, nervous or worried?," was used to assess frequency of alcohol self-medication. This second item was required in RedCap to ensure the key study variable of alcohol self-medication was obtained for each participant.

Patient-Reported Outcomes Measurement Information System (PROMIS) Bank v1.0 – Anxiety: The PROMIS Bank v1.0 – Anxiety is composed of 29 self-report items developed by the NIH Roadmap initiative that assesses fear (fearfulness, panic), anxious misery (worry, dread), hyperarousal (tension, nervousness, restlessness) and somatic symptoms (racing heart, dizziness) in the past seven days and is administered by computer adaptive testing (CAT; PROMIS: Patient-Reported Outcomes Measurement Information System, 2019; Pilkonis et al., 2011). Using CAT, participants' subsequent items are determined by their response to previous items, and participants answer a minimum of four items to receive a T score (PROMIS: Patient-Reported Outcomes Measurement Information System, 2019). A T score of 50 is the average for the U.S. general population ($SD = 10$), with higher T scores indicating higher anxiety (PROMIS:

Patient-Reported Outcomes Measurement Information System, 2019). PROMIS Anxiety has been extensively evaluated using qualitative and quantitative methods, and has shown excellent content validity (Pilkonis et al., 2011).

Coronavirus Anxiety Scale: The Coronavirus Anxiety Scale (CAS) is a 5-item scale assessing the state cognitive, behavioral, emotional, and physiological experiences of anxiety associated with COVID-19 over the past two weeks (Lee, Mathis et al., 2020). Items are assessed on a scale of 0 = *not at all* to 4 = *nearly every day* with higher scores indicating higher COVID-19 associated anxiety (Lee, Mathis et al., 2020). Confirmatory factor analysis supports the single-factor model, and items are highly reliable ($\alpha = 0.80–0.93$; Evren et al., 2020; Lee, Mathis et al., 2020). Cronbach's α was .881 in the present study. Items are summed to score, and a score ≥ 9 is indicative of problematic COVID-19 related anxiety (Lee, Mathis et al., 2020). Validity of this tool has been demonstrated by its strong positive correlation with functional impairment, passive suicidal ideation, and the Obsession with COVID-19 Scale (Evren et al., 2020; Lee, Mathis et al., 2020). All items were required in RedCap to ensure the key study variable of COVID-19 anxiety was obtained for each participant.

Measures of the Quantity and Frequency of Alcohol Use

In this study in order to investigate the quantity and frequency of alcohol use, the PI used the Alcohol Use Disorders Identification Test (AUDIT) and AUDIT-C and questions from the Alcohol Intake Questionnaire (V3.2) that evaluate the frequency of binge drinking over the past 30 days, and intensity of binge drinking (number of drinks per binge episode) over the past 30 days. As detailed below the AUDIT and AUDIT-C have been used extensively to detect heavy and high-risk or hazardous dinking. Binge drinking is considered high-risk or hazardous drinking. The AUDIT and AUDIT-C have been used to assess for a binge pattern of drinking,

because the AUDIT question #3: “How often do you have X or more drinks on one occasion? (5 for men under age 65; 4 for men aged 65 or older and all women). Scores on both the AUDIT and AUDIT-C have been used to detect current alcohol abuse or dependence.

USAUDIT: The AUDIT is a 10-item survey developed by the World Health Organization originally developed to detect heavy adult drinkers (Cortés-Tomás et al., 2016; Margret & Ries, 2016). Participants completed the USAUDIT, which has been adapted to adjust for the standard United States drink size (14 grams versus 10 grams of alcohol; Higgins-Biddle, 2018). Items are summed for scoring, and a cutoff score of 6 or more on the AUDIT has been shown to detect 91% of young adults engaged in binge drinking (defined as four or more occasions in which 5+/4+ drinks were consumed in one sitting over the past 28 days; Piano et al., 2017). Previous studies have found AUDIT scores were significantly greater among young adult binge drinkers compared to abstainers and moderate drinkers (Piano et al., 2015). A Cronbach’s alpha of 0.89 was generated for the scores in this study.

USAUDIT-C: The AUDIT-C includes the first three items of the USAUDIT, including two items about the frequency of alcohol consumption and one item about the intensity of alcohol consumption. Items are scored from 0 to 4 and summed for total score. Previous research identified an AUDIT-C score of ≥ 4 is indicative of a DSM-V diagnosis of alcohol use disorder in a young adult population (ages 18 to 30 years; Hagman, 2016). The Cronbach’s alpha in the present study was 0.74.

7-Day Timeline Follow Back (TLFB-7): The TLFB is a calendar-based form in which participants report their estimated alcohol consumption on each day of the calendar over the past 30 days, 90 days, or 12 months including days of abstinence (Sobell & Sobell, 1992). Test-retest reliability of this instrument and concurrent validity with the Alcohol Dependence Scale and

Michigan Alcohol Screening Test have been established (Sobell & Sobell, 1992). The rationale for the use of the 7-day self-administered TLFB-7 is college students reported more drinking days on the TLFB-7 than the 30-day TLFB-30, suggesting the shorter interval of the TLFB-7 increases the accuracy of reported drinking events (Hoeppner et al., 2010).

Alcohol Intake Questionnaire (AIQ): The AIQ is a 20-item tool that includes modified versions of the NIAAA questions on binge drinking, questions with and without time qualifiers (e.g., "During your last drinking episode, how fast did you consume the alcoholic beverage?"), and open-ended questions to determine the frequency of binge drinking and the largest number of drinks consumed in the past 30 days (Piano et al., 2017). The AIQ was used to evaluate participant self-report of binge drinking in the past 30 days.

Data Analysis

Data analyses were conducted using IBM SPSS Statistics software. Statistical significance tests maintained type I error rates of ≤ .05.

Missing Data

Evaluations of instrument normality were completed post hoc. Participants who did not complete the AUDIT were excluded from final analysis. No nonrandom patterns were observed in the remaining study measures missing responses. Therefore, multiple imputation of the missing data values was conducted using the fully conditional specification of the Markov Chain Monte Carlo algorithm implemented in the SPSS software (Van Buuren, 2007; Van Buuren et al., 2006). Analyses were conducted both with the imputed data and with the original dataset with missing values. Eleven participants stated they "never" drank alcohol to calm down and also reported when they drank alcohol, less than 1% of the time they did so in order to calm down. The responses for the nominal item "Did you EVER drink alcohol to calm down or to help

calm down or quiet your nerves when you felt tense, nervous, or worried?" were adjusted from "No" to "Yes" for these participants.

Statistical Analyses

Descriptive statistics were used to summarize the characteristics of the study sample. Descriptive statistical and graphical summaries of the distributions of the responses to the study measures were examined for outliers and the need for possible transformations prior to conducing hypotheses tests. The distributions of CAS, AUDIT, alcohol frequency, alcohol intensity, and frequency of drinking to calm down data values were not normally distributed. Generating square root values was performed to transform the MDMQ-R anxiety subscale, AUDIT, frequency of drinking to calm down, and alcohol use frequency values to normal distributions; a logarithmic transformation was required for the CAS values and an inverse transformation for the AIQ frequency values.

Aim 1: Determination of the associations of general and COVID-19 specific anxiety with the AUDIT scores were conducted using multiple linear regressions. The PI conducted unadjusted and adjusted (age and sex covariates) analyses.

Aims 2 and 3: Assessment of the mediation effects of motives (MDMQ-R) and self-medication (NESARC) on the associations of anxiety (PROMIS Anxiety score, and Coronavirus Anxiety Scale) with alcohol consumption behavior (AUDIT, AUDIT-C, frequency, intensity) were conducted using linear regression and the PROCESS macro in SPSS (Hayes, 2017). In each of those models, age and sex were included as covariates. Tests of the statistical significance of each of the mediation effects were conducted using the Sobel test.

Sample Size Justification and Statistical Power

The sample size for this study was derived from observed effects published in the literature at the time of study conception. The sample of 175 participants was based on the desire to detect an association of anxiety (PROMIS or CAS) with the AUDIT scores as small as $\beta = 0.20$ (4% shared variance) assuming the associations of sex and age would account for as much as 30% of the variance in AUDIT scores (80% statistical power, $\alpha = .05$). Furthermore, a mediation effect as small as $\beta = 0.13$ of either motives or self-medication on those associations of anxiety with AUDIT would be detectable assuming the two simple regression coefficients of anxiety with AUDIT and motives/self-medication with AUDIT would be in the range of $\beta = 0.3 – 0.4$ (80% statistical power, $\alpha = .05$).

CHAPTER 4

RESULTS

Demographic and drinking characteristics of study participants are described first, followed by the results of the multiple and hierarchical regressions used to test the three study aims will be presented. Finally, additional analyses of interest will be reviewed.

Demographic Characteristics

Sample characteristics of all 203 respondents and the 182 who completed the primary outcome variables (AUDIT) are summarized in Table 4. There were no significant differences between participants included in the final analysis and participants who were excluded from the analysis ($p > .05$).

Table 4

*Demographic Characteristics of Respondents and by Analysis Sample**

	Total (*N* = 203)	**Final analysis sample (*n* = 182) *n* (%)**	**Excluded from analysis (*n* = 21)**
Sex			
Male	85 (41.9)	80 (44.0)	5 (23.8)
Female	118 (58.1)	102 (56.0)	16 (76.2)
Race/ethnicity[1]			
White	180 (88.7)	162 (89.0)	18 (85.7)
Hispanic or Latino	16 (7.9)	15 (8.2)	1 (4.8)
Black or African American	6 (3.0)	5 (2.7)	1 (4.8)
Native American or American Indian	5 (2.5)	5 (2.7)	0 (0)
Asian/Pacific Islander	12 (5.9)	11 (6.0)	1 (4.8)
Marital status			
Single	143 (70.4)	130 (71.4)	13 (61.9)
Married	57 (28.1)	50 (27.5)	7 (33.3)
Divorced	2 (1.0)	2 (1.1)	0 (0)
Year in school			
Freshman	7 (3.4)	7 (3.8)	0 (0)

Sophomore	16 (7.9)	15 (8.2)	1 (4.8)
Junior	14 (6.9)	13 (7.1)	1 (4.8)
Senior	50 (24.6)	47 (25.8)	3 (14.3)
Graduate student	77 (37.9)	69 (37.9)	8 (38.1)
Enrollment type			
Full-time student	127 (62.6)	117 (64.3)	10 (47.6)
Part-time student	32 (15.8)	30 (16.5)	2 (9.5)
Class attendance Fall 2020			
Online	64 (31.5)	62 (34.1)	2 (9.5)
Hybrid (combination in-person and online)	80 (39.4)	72 (39.6)	8 (38.1)
Other	18 (8.8)	16 (8.7)	2 (9.5)
Living situation			
On-campus	18 (8.9)	16 (8.8)	2 (9.5)
Off-campus	142 (70.0)	132 (72.5)	10 (47.6)
Employment status			
Full time (≥ 40 hours weekly)	71 (35.0)	64 (35.2)	7 (33.3)
Part time (< 40 hours weekly)	62 (30.5)	56 (30.8)	6 (28.6)
Unemployed	64 (31.5)	60 (33.0)	4 (19.0)
Estimated total household income 2019-2020*			
< $30,000	61 (30.0)	57 (31.3)	4 (19.0)
$30,000 - $40,000	29 (14.3)	28 (15.4)	1 (4.8)
$40,000 - $60,000	29 (14.3)	23 (12.6)	6 (28.6)
$60,000 - $80,000	19 (9.4)	18 (9.9)	1 (4.8)
$80,000 - $100,000	11 (5.4)	11 (6.0)	0 (0)
$100,000 - $150,000	21 (01.3)	17 (9.3)	4 (19.0)
$150,000 - $200,000	12 (5.9)	12 (6.6)	0 (0)
➢ $200,000	12 (5.9)	12 (6.6)	0 (0)
		Mean (*SD*)	
	Total (*n* = 177)	**Final analysis sample (*n* = 182)**	**Excluded from analysis (*n* = 21)**
Age (years)	25.2 (3.4)	25.1 (3.4)	26.3 (3.1)

[1]: participants were given the option to select all applicable race/ethnicities
*All tests of differences, $p > 0.5$

Among the 182 participants in the final analysis sample, 56% were female (n = 102) and 44% were male (n = 80). The majority were White (89.0%) with a mean age of 25.1 (SD = 3.4). A majority of participants were seniors in college (25.8%, n = 47) or graduate students (37.9%, n = 69). Seventy-two and a half percent of participants reported living off-campus (n = 132), and 73.7% of participants reported attending classes online or in a hybrid format (i.e., combination of

in-person and online; *n* = 134) during the Fall 2020 semester. Seventy-one percent of participants were single (*n* = 130). Thirty-five percent of participants were employed full time (*n* = 64), and 30.8% of participants were employed part time (< 40 hours of work per week; *n* = 56). The majority of participants reported estimated total household income in 2019–2020 less than $60,000 per year (59.3%, *n* = 108).

Summaries of reported alcohol use are shown in Table 5. Approximately 93% (*n* = 169, 92.9%) of participants reported consuming alcohol (based on total AUDIT score). Forty-one percent point two of participants reported binge drinking (defined as drinking more than four or five drinks in a single occasion) in the past 7 days, and 86.3% of participants reported binge drinking on at least one occasion in the past 30 days. The median number of drinks consumed on one occasion for all participants was 3.0 [IQR 2.0, 4.0] and of those who reported binge drinking, the median number of binge episodes in the past 30 days was 4.3 [IQR 1.0, 5.0]. Thirty-four and a half percent (*n* = 70 of 182) of participants reported having a family history of alcohol abuse, approximately 43% (*n* = 87) of participants reported a history of blacking out (defined as amnesia or memory loss for all or part of a drinking episode), and 51.2% (*n* = 104) of participants reported participating in drinking games.

Table 5

Summary of Participant Alcohol Use Patterns (N = 182)

	Median	IQR	Min	Max	N
Number of days per week drinking reported on AIQ	3.0	[2.0 – 4.0]	1	7	142
Number of days drank in past 7 days reported on TLFB-7	3.0	[2.0 – 5.0]	0.0	7.0	129
Number of drinks consumed per occasion reported on AIQ	3.0	[2.0 – 4.0]	1.0	12.0	141
Average number of drinks consumed per occasion reported on TLFB-7	1.4	[0.57 – 2.4]	0.0	9.6	124

Total number of drinks consumed in past 7 days reported on TLFB-7	9.5	[4.0 – 16.8]	0.0	67.0	124
Number of binge episodes[1] in the past 7 days reported on AIQ	0.0	[0.0 – 1.0]	0.0	6.0	142
Number of binge episodes[1] in the past 7 days reported on TLFB-7	0.0	[0.0 – 1.0]	0.0	6.0	129
Average number of drinks consumed during binge episode[1] reported on TLFB-7	6.5	[4.7 – 7.5]	4.0	12.2	54
Number of binge episodes in past 30 days[1] reported on AIQ	4.3	[1.0 – 5.0]	0.0	28.0	142
Maximum number of drinks consumed on any occasion during the past 30 days reported on AIQ	6.0	[4.0 – 10.0]	0.0	21.0	141
Number of blackouts in past month[2] reported on AIQ	0.0	[0.0 – 1.0]	0.0	12.0	87
AUDIT score	8.5	[5.0 – 14.0]	0.0	31.0	182
AUDIT – C score	5.0	[4.0 – 7.0]	0.0	12.0	182
		N		%	
Alcohol use behavior[2]					
Abstainer[2]		13		7.1	
Low risk consumption[2]		66		36.2	
Hazardous or Harmful Consumption[2]		66		36.2	
Likely alcohol dependence[2]		37		20.5	
Reported drinking alcohol on AIQ					
Yes		142		78.0	
No		13		7.1	
Reported binge drinking episode[1] in the past 7 days on TLFB-7					
Yes		131		72.0	
No		39		21.4	
Ever drink to calm down					
Yes		120		65.9	
No		50		27.5	
Family history of alcohol abuse					
Yes		70		34.5	
No		86		42.4	
History of blackout[3]					
Yes		87		42.9	
No		55		27.1	
Participated in drinking games					
Yes		104		51.2	
No		37		18.2	

[1]: binge episode is defined as having more than 4–5 drinks in a single occasion; [2] based on total AUDIT score (abstainer: AUDIT score = 0; low risk consumption: AUDIT score = 1–7;

hazardous or harmful consumption: AUDIT score = 8–14; likely alcohol dependence: AUDIT score ≥ 15); [3]: blackout is defined as amnesia or memory loss for all or part of a drinking episode

The mean AUDIT-C score in the present study was 5.4 (*SD* = 2.8; $Mean_{Male}$ = 6.3, SD_{Male} = 2.4; $Mean_{Female}$ = 4.7, SD_{Female} = 2.9). Scores ≥ 4 for men and ≥ 3 for women on the AUDIT-C indicate positive screens for alcohol misuse, indicating that on average both men and women in the present study screened positive for alcohol misuse (Rubinsky et al., 2013). USAUDIT data was not normally distributed in the present study. Median AUDIT score was 8.5 [IQR 5.0 – 14.0]. USAUDIT Score of > 6 indicated at-risk drinking in young adults (Piano et al., 2017). Seventy-one percent of participants in had an AUDIT score > 6, which demonstrated the majority of participants in this study were at-risk drinkers.

Bivariate Pearson's correlations were conducted to corroborate AUDIT, AUDIT-C, AIQ derived alcohol use frequency ("How many times did you have more than 4-5 drinks on a single occasion in the last 30 days?") and alcohol use intensity ("During your last drinking episode, how fast did you consume the alcoholic beverage?") values. Bivariate correlations are summarized in Table 6. All relationships were statistically significant at the level of $p<.001$ and had effect sizes $r \geq 0.45$ indicating strong associations between these variables.

Table 6

Bivariate Association Between Outcome Variables (N = 182)

	AUDIT-C score	Alcohol use frequency[1]	Alcohol use intensity[2]
AUDIT score	.87*	. 80*	.53*
AUDIT-C score	-	.84*	.45*
Alcohol use frequency	-	-	.45*

*$p < .001$; [1]: AIQ, "How many times did you have more than 4-5 drinks on a single occasion in the last 30 days?"; [2]: AIQ, "During your last drinking episode, how fast did you consume the alcoholic beverage?"

Actual and imputed values to the other key study measures are summarized in Table 7. Final results did not differ between analyses conducted with actual and imputed responses. Results reported herein are the results of analyses conducted with imputed responses.

Table 7

Descriptive Statistical Summary of Key Study Variables

	Total	Imputed	N missing
	Mean (*SD*)		
Age	25.1 (3.4)	25.0 (3.4)	23
PROMIS Anxiety T score[1]	63.2 (8.2)	63.2 (8.2)	0
	Median [IQR]		
Coronavirus Anxiety Scale score[2]	6.0 [5.0 – 10.0]	6.0 [5.0 – 10.0]	12
MDMQ-R Anxiety Subscale score	2.5 [1.7 – 3.5]	2.5 [1.7 – 3.5]	8
Percent of time drinking to calm down	15.0 [1.0 – 50.0]	15.0 [0.0 – 50.0]	17

[1]: Mean PROMIS Anxiety score in United States: 50; *SD*: 10; [2]CAS score ≥ 9 indicates probable dysfunctional coronavirus-related anxiety

The average PROMIS Anxiety score in this study was 63.2 (*SD* = 8.2). A PROMIS Anxiety T score of 50 is the average for the U.S. general population (*SD* = 10; PROMIS: Patient-Reported Outcomes Measurement Information System, 2019). A higher PROMIS T score represents higher anxiety (PROMIS: Patient-Reported Outcomes Measurement Information

System, 2019). Therefore, the average value for participants in this study was 23.3% higher than the general U.S. population.

The median CAS score in this study was 6.0 with 50% of the participants having scores between 5.0 and 10.0. Previous studies using the CAS have reported mean total CAS scores ranging from 1.29 (*SD* = 2.39) to 6.66 (*SD* = 2.65; Choi et al., 2020; Evren et al., 2020; Skalski et al., 2021). Thus, the median in this study was higher than those reports. A value of ≥ 9 indicated probable dysfunctional coronavirus-related anxiety (S. A. Lee, 2020).

As shown in Table 7, the median MDMQ-R Anxiety Subscale score was 2.5 [IQR 1.75 – 3.25] and was higher than a previously reported mean MDMQ-R Anxiety Subscale score in a similar population (*M* = 1.94, *SD* = 0.74; Grant et al., 2009). Furthermore, in the present study, 72.0% (*n* = 131) of participants reported ever using alcohol for self-medication. In the original NESARC representative survey of the adult U.S. population, 23.4% (*n* = 1971) of participants reported ever using alcohol for self-medication (J. Robinson et al., 2009).

Analysis of Hypotheses

Specific Aim 1: To determine the association of anxiety with alcohol use (frequency and intensity) in young adults ages 18 to 30 years.

Hypothesis 1a: Higher scores on the PROMIS Anxiety Scale will be positively associated with AUDIT and AUDIT-C scores and binge drinking frequency and intensity in young adults.

Summaries of the unadjusted and adjusted bivariate associations of PROMIS Anxiety scores with the measures of alcohol consumption are shown in Table 8. Validating the need to control for age and sex in these analyses, statistically significant associations of those variables

with each of the alcohol drinking measures was found (all $p < .05$). Furthermore, while the unadjusted correlations of the PROMIS Anxiety scores with each of the drinking measures were positive and statistically significant ($p < .05$), the strength of those correlations were higher after controlling for the effects of age and sex. The strongest adjusted positive associations for the PROMIS Anxiety scores were observed with the two AUDIT measures (AUDIT: $\beta = .39$, AUDIT-C: $\beta = .33$, both $p < .001$) accounting for 24% and 23% of the variability in those measures respectively. The strengths of the adjusted associations were lower; yet, similar with the binge drinking frequency and intensity measures (frequency: $\beta = .26$, intensity: $\beta = .25$, both $p < .01$) accounting for 6–8% of the variability in those measures.

Table 8

Summary of Univariate and Multivariate Association Among Age, Sex, PROMIS-Anxiety T Score, AUDIT, AUDIT-C, Alcohol Use Frequency and Alcohol Use Intensity (N = 182)

	r	*p* value	beta	*p* value
		AUDIT		
Age	.30	< .001	.27	< .001
	(.27)	(< .001)	(.27)	(< .001)
Sex	-.19	.012	-.27	< .001
	(-.15)	(.052)	(-.28)	(< .001)
PROMIS Anxiety T score	.32	< .001	.39	< .001
	(.32)	(< .001)	(.42)	(< .001)
		AUDIT-C		
Age	.28	< .001	.24	< .001
	(.26)	(.001)	(.24)	(.001)
Sex	-.28	< .001	-.35	< .001
	(-.26)	(.001)	(-.37)	(< .001)
PROMIS Anxiety T score	.24	< .01	.33	< .001
	(.22)	(.005)	(.35)	(< .001)
		Alcohol use frequency[1]		
Age	.15	.070	.15	.073
	(.18)	(.046)	(.19)	(.034)
Sex	-.03	.742	-.11	.230

	(-.02)	(.796)	(-.11)	(.236)
PROMIS Anxiety T score	.22	.008	.26	.003
	(.21)	(.016)	(.27)	(.005)
		Alcohol use intensity[2]		
Age	.13	.124	.11	.187
	(.14)	(.129)	(.13)	(.140)
Sex	-.19	.027	-.26	.003
	(-.17)	(.064)	(-.25)	(.009)
PROMIS Anxiety T score	.15	.071	.25	.005
	(.14)	(.126)	(.24)	(.011)

Note. Sex: 1 = male, 2 = female; [1]: AIQ, "How many times did you have more than 4-5 drinks on a single occasion in the last 30 days?"; [2]: AIQ, "During your last drinking episode, how fast did you consume the alcoholic beverage?"

AUDIT: Multiple $R = .501$, $p < .001$; $R^2 = .251$ (Adjusted $R^2 = .239$)

AUDIT-C: Multiple $R=.495$, $p < .001$; $R^2 = .245$ (Adjusted $R^2 = .232$)

Alcohol Use Frequency: Multiple $R = .289$, $p = .007$; $R^2 = .083$ (Adjusted $R^2 = .064$)

Alcohol Use Intensity: Multiple $R = .317$, $p = .002$; $R^2 = .101$ (Adjusted $R^2 = .081$)

Hypothesis 1b: Higher scores on the CAS will be positively associated with AUDIT and AUDIT-C scores and binge drinking frequency in young adults.

The unadjusted and adjusted bivariate associations of the CAS with the measures of alcohol consumption are summarized in Table 9. While in a positive direction, the associations of the CAS with the alcohol drinking measures were not as strong as those observed for the PROMIS Anxiety measure. The strongest unadjusted correlations were observed for the CAS with the AUDIT and with the measure of binge drinking frequency ($r = .26$, $p \leq .001$; $r = .25$, $p < .01$ respectively). The strength of the CAS associations was also higher after controlling for the effects of age and sex; however, not to the extent observed for the PROMIS anxiety scores. The

strongest adjusted association was observed with the AUDIT measure (β = .32, $p < .001$) accounting for 19% of the variability in this measure. Adjusted associations with the other measures of drinking behavior were lower, ranging from 0.24 (AIQ Intensity) to 0.27 (AIQ Frequency; all $p < .01$) uniquely accounting for 7–8% of the variability in these measures.

Table 9

Summary of Univariate and Multivariate Association Among Age, Sex, CAS Score, AUDIT, AUDIT-C, Alcohol Use Frequency, and Alcohol Use Intensity (N = 182)

	r	*p* value	beta	*p value*
		AUDIT		
Age	.30	<.001	.26	<.001
	(.31)	(<.001)	(.28)	(<.001)
Sex	-.19	.012	-.25	.001
	(-.17)	(.043)	(-.32)	(.004)
CAS score	.26	<.001	.31	<.001
	(.21)	(.010)	(.27)	(.001)
		AUDIT-C		
Age	.28	<.001	.24	.001
	(.29)	(<.001)	(.25)	(.001)
Sex	-.28	<.001	-.33	<.001
	(-.29)	(<.001)	(-.33)	(<.001)
CAS score	.18	.175	.25	<.001
	(.10)	(.216)	(.20)	(.013)
		Alcohol use frequency[1]		
Age	.15	.070	.12	.144
	(.18)	(.046)	(.15)	(.094)
Sex	-0.3	.742	-.11	.215
	(-.02)	(.796)	(-.11)	(.236)
CAS score	.25	.003	.27	.002
	(.25)	(.005)	(.28)	(.003)
		Alcohol use intensity[2]		
Age	.13	.124	.08	.313
	(.14)	(.129)	(.09)	(.290)
Sex	-.19	.027	-.26	.003
	(-.17)	(.064)	(-.26)	(.007)
CAS score	.17	.047	.25	.004
	(.18)	(.044)	(.27)	(.005)

Note. Sex: 1 = male, 2 = female; [1]: AIQ, "How many times did you have more than 4-5 drinks on a single occasion in the last 30 days?"; [2]: AIQ, "During your last drinking episode, how fast did you consume the alcoholic beverage?"

AUDIT: Multiple $R = .448$, $p < .001$; $R^2 = .201$ (Adjusted $R^2 = .187$)

AUDIT-C: Multiple $R = .451$, $p < .001$; $R^2 = .203$ (Adjusted $R^2 = .190$)

Alcohol Use Frequency: Multiple $R = .298$, $p = .005$; $R^2 = .089$ (Adjusted $R^2 = .069$)

Alcohol Use Intensity: Multiple $R = .319$, $p = .002$; $R^2 = .102$ (Adjusted $R^2 = .082$)

Results of Aims 2 and 3

For the analysis of Aims 2 and 3, we used the AUDIT and AUDIT-C scores, as measures of alcohol use frequency and intensity, since as noted above items 1 and 3 on the AUDIT are measures of alcohol use frequency and item 2 of the AUDIT is a measure of alcohol use intensity. Also and importantly, because of the strong correlation between the AUDIT, AUDIT-C and AIQ-derived frequency and intensity items it was thought analysis of the latter variables would be redundant.

<u>Specific Aim 2</u>: To examine the mediational effect of drinking to cope with anxiety on the association of anxiety with alcohol use (frequency and intensity) in young adults ages 18 to 30 years.

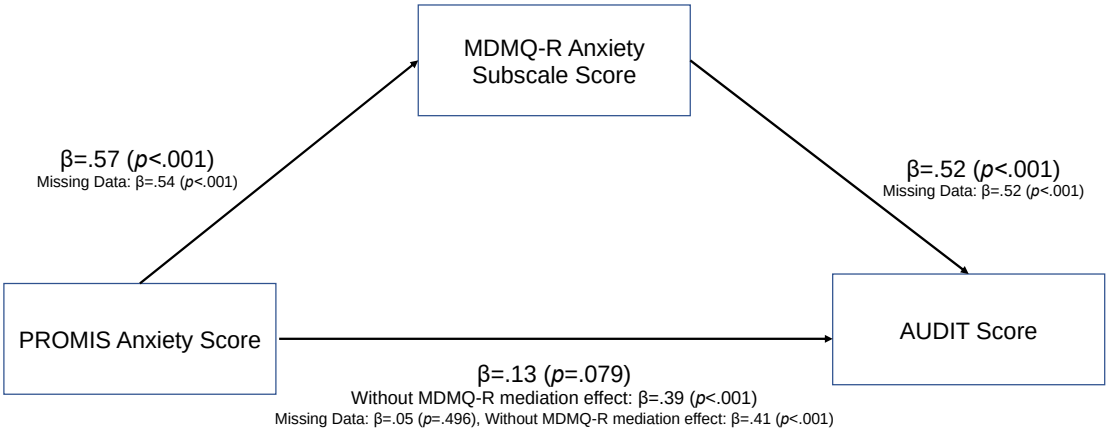
Hypothesis 2a: Drinking to cope with anxiety (the Modified Drinking Motives Questionnaire - Revised coping subscale score) will mediate the relationship of the PROMIS Anxiety score with the AUDIT and AUDIT-C score.

The direct and mediating effects of the PROMIS Anxiety and drinking to cope with anxiety (the MDMQ-R Anxiety subscale score) on alcohol use as measured by the AUDIT, after

controlling for age and sex, are shown in Figure 1. The direct effect of the PROMIS Anxiety scores was positive and accounted for 15% of the variability in the AUDIT scores (β = .39, *p* < .001). A test of the hypothesized mediating effect of drinking to cope with anxiety on that relationship was statistically significant (Sobel test: *z* = 6.21, *p* < .001). With the mediating effect of drinking to cope with anxiety in the model, the effect of the PROMIS Anxiety scores was reduced to accounting for only 2% of the variability in the AUDIT scores and was no longer statistically significant (β = .13, *p* = .079; Figure 1).

Figure 1

Mediation Effect of MDMQ-R Anxiety Subscale Score on the Association Between PROMIS Anxiety Score and AUDIT Score

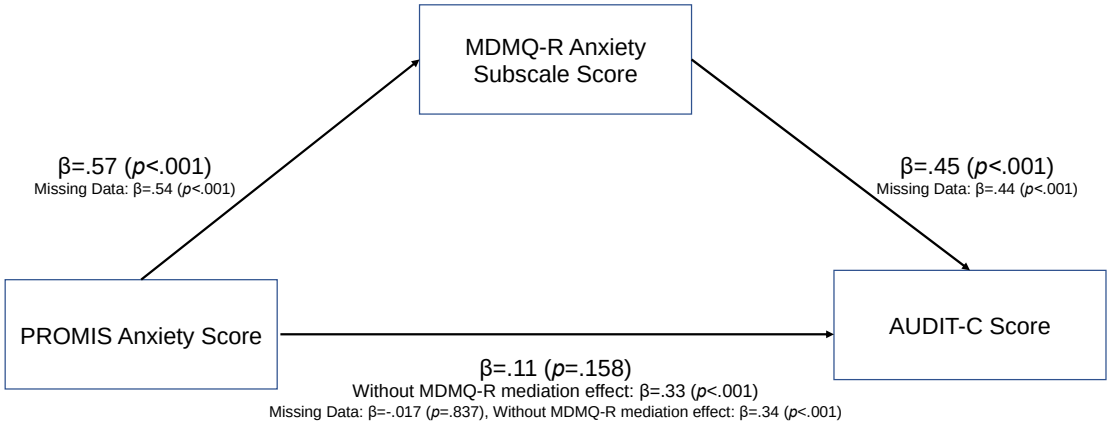


As would be expected given the findings from the AUDIT model, similar direct and mediating effects of the PROMIS and drinking to cope with anxiety (MDMQ-R anxiety subscale score) were observed on the AUDIT-C scores after controlling for age and sex as exhibited in Figure 2. The direct effect of the PROMIS Anxiety scores was positive and accounted for 2% of the variability in the AUDIT-C scores (β = .33, *p* < .001). A test of the hypothesized mediating

effect of drinking to cope with anxiety on that relationship was statistically significant (Sobel test: $z = 5.60$, $p < .001$). With the mediating effect of drinking to cope with anxiety in the model, the effect of the PROMIS Anxiety scores was reduced to accounting for only 1% of the variability in the AUDIT-C scores and was no longer statistically significant ($\beta = .11$, $p = .158$; Figure 2).

Figure 2

Mediation Effect of MDMQ-R Anxiety Subscale Score on the Association Between PROMIS Anxiety Score and AUDIT-C Score



Hypothesis 2b: Drinking to cope with anxiety (the Modified Drinking Motives Questionnaire - Revised anxiety coping subscale score) will mediate the relationship of the Coronavirus Anxiety Scale score with the AUDIT and AUDIT-C score.

Illustrations of the direct and mediating effects of the COVID Anxiety (CAS) and drinking to cope with anxiety on drinking behavior as measured by the AUDIT and the AUDIT-C, after controlling for age and sex, are shown in Figures 3 and 4 respectively. The direct effect of the CAS scores on these measures was positive; however, did not account for as much

variability in the drinking behavior scores as did the PROMIS (AUDIT: 9%, β = .31; AUDIT-C: 6%, β = .25; both $p < .001$). Nevertheless, the mediating effect of drinking to cope with anxiety on both of those relationships was statistically significant (AUDIT: $z = 4.72$, $p < .001$; AUDIT-C: $z = 4.43$, $p < .001$). With the mediating effect of drinking to cope with anxiety in the model, the effect of the CAS scores was reduced to accounting for only 1% of the variability in the AUDIT scores and 1% in the AUDIT-C scores. Neither of the remaining effects of the CAS scores were statistically significant (AUDIT: β = .12, $p = .080$; AUDIT-C: β = .09, $p = .219$; Figures 3 and 4).

Figure 3

Mediation Effect of MDMQ-R Anxiety Subscale Score on the Association Between CAS Score and AUDIT Score

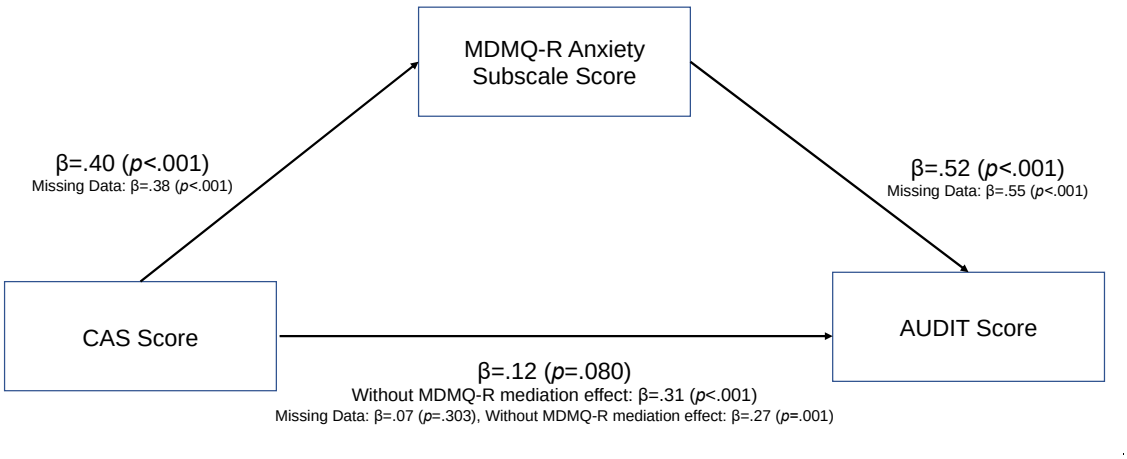
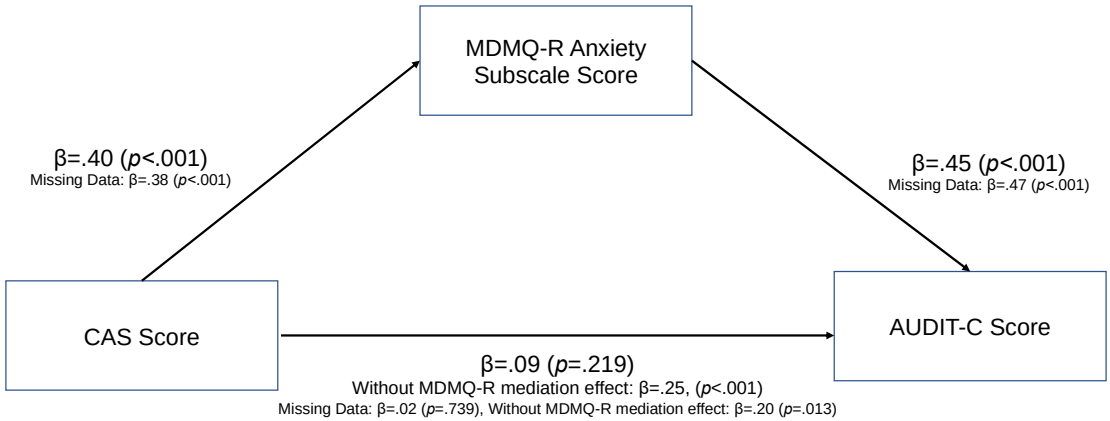


Figure 4

Mediation Effect of MDMQ-R Anxiety Subscale Score on the Association Between CAS Score and AUDIT-C Score



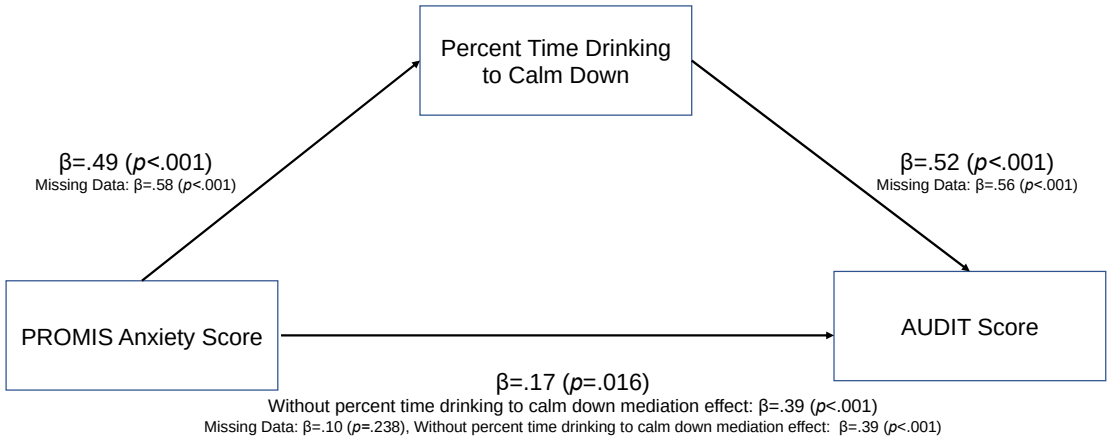
<u>Specific Aim 3</u>: To examine the mediational effect of alcohol self-medication on the association of anxiety with alcohol use (frequency and intensity) in young adults ages 18 to 30 years.

Hypothesis 3a: Self-report of alcohol self-medication will mediate the relationship between PROMIS Anxiety score and AUDIT and AUDIT-C score.

Illustrations of the direct and mediating effects of the PROMIS Anxiety and the percentage of time drinking to calm down on drinking behavior as measured by the AUDIT, after controlling for age and sex, are shown in Figure 5. A test of the hypothesized mediating effect of alcohol self medication (the percentage of time drinking to calm down) on that relationship was statistically significant (Sobel test: $z = 5.61$, $p < .001$). With the mediating effect of alcohol self medication in the model, the effect of the PROMIS Anxiety scores was reduced to accounting for only 3% of the variability in the AUDIT scores ($\beta = .17$, $p = .016$; Figure 5).

Figure 5

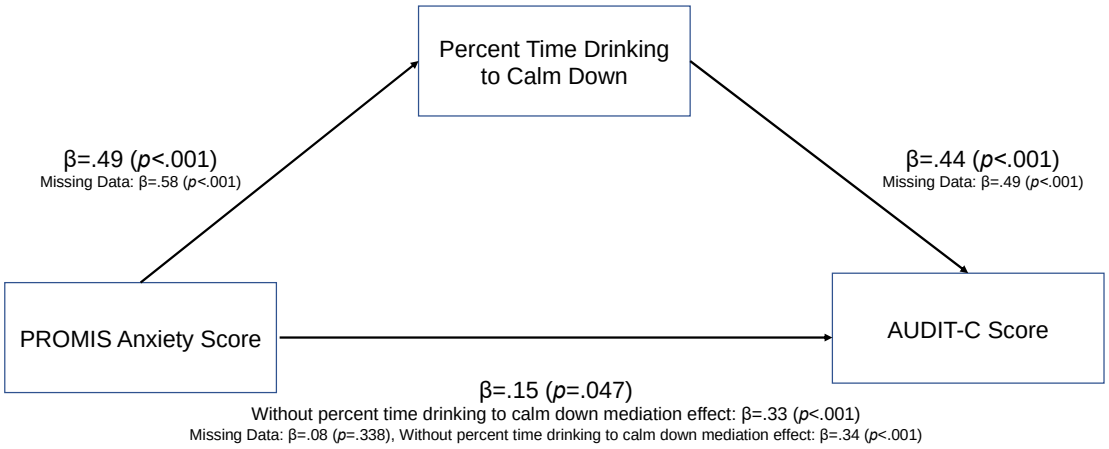
Mediation Effect of Percent Time Drinking to Calm Down on the Associate Between PROMIS Anxiety Score and AUDIT Score



Similar direct and mediating effects of the PROMIS and alcohol self medication (percentage of time drinking to calm down) were observed on the AUDIT-C scores after controlling for age and sex (Figure 6). A test of the hypothesized mediating effect of the percent time drinking to calm down on that relationship was statistically significant (Sobel test: $z = 5.12$, $p < .001$). With the mediating effect of alcohol self medication in the model, the effect of the PROMIS Anxiety scores was reduced to accounting for only 2% of the variability in the AUDIT-C scores ($\beta = .15$, $p = .047$ from $\beta = .33$, ($p < .001$; Figure 6).

Figure 6

Mediation Effect of Percent Time Drinking to Calm Down on the Association Between PROMIS Anxiety Score and AUDIT-C Score



Hypothesis 3b: Self-report of alcohol self-medication will mediate the relationship between Coronavirus Anxiety Scale score and AUDIT and AUDIT-C score.

Illustrations of the direct and mediating effects of the COVID Anxiety (CAS) and alcohol self medication (the percentage of time drinking to calm down) on drinking behavior as measured by the AUDIT and the AUDIT-C, after controlling for age and sex, are shown in Figures 7 and 8 respectively. The mediating effect of alcohol self medication on both of those relationships was statistically significant (AUDIT: $z = 4.44$, $p < .001$; AUDIT-C: $z = 4.55$, $p < .001$). With the mediating effect of alcohol self medication in the model, the effect of the COVID Anxiety scores was reduced to accounting for only 2% of the variability in the AUDIT scores and 1% in the AUDIT-C scores. While the effect of the CAS score on AUDIT score decreased, it remained significant ($\beta = .13$, $p = .048$; see Figure 7). The remaining effect of the CAS score on AUDIT-C was no longer statistically significant ($\beta = .10$, $p = .148$; Figure 8).

Figure 7

Mediation Effect of Percent Time Drinking to Calm Down on the Association Between CAS Score and AUDIT Score

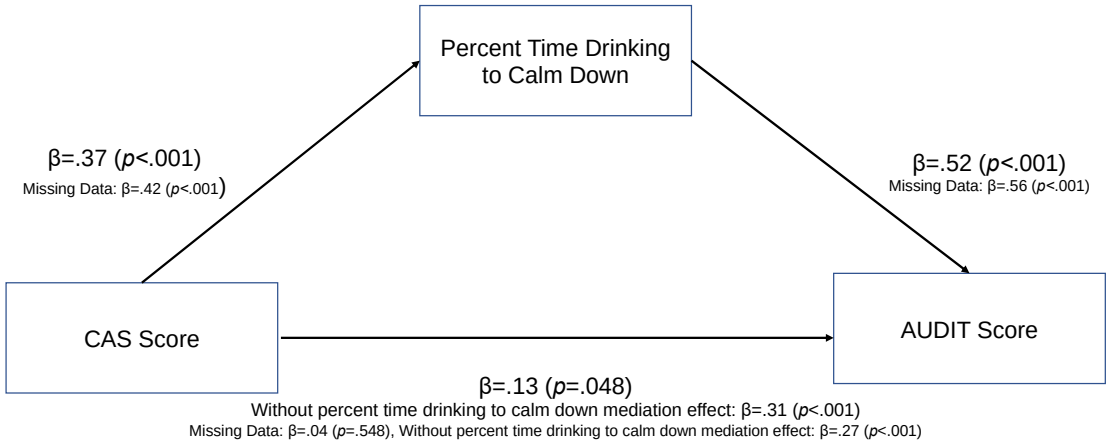
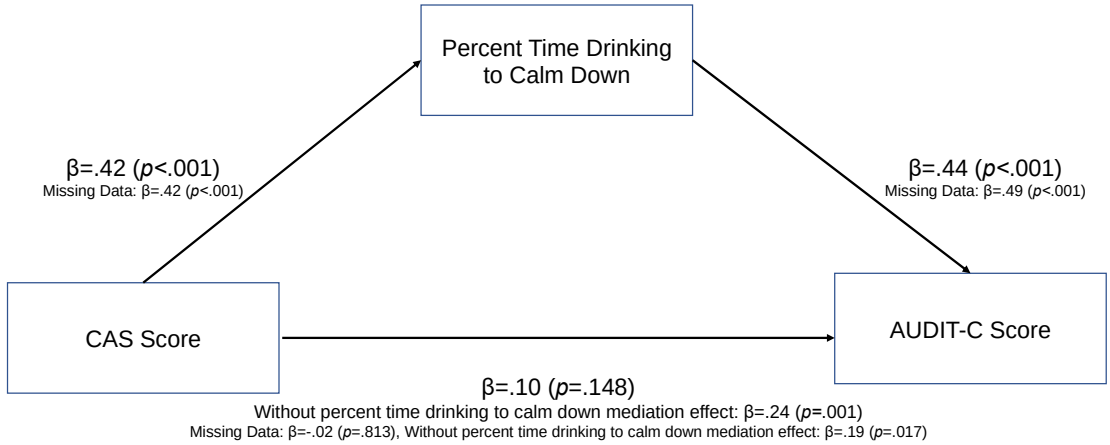


Figure 8

Mediation Effect of Percent Time Drinking to Calm Down on the Association Between CAS Score and AUDIT-C Score



Additional Study Results

Statistically significant positive correlations were observed between both measures of anxiety and the number of binge episodes in the last 30 days (n= 142; PROMIS: $r_s = .23$, p

= .005; CAS: r_s = .24, p = .003). No statistically significant differences in anxiety were observed; however, between the two groups defined as low and high risk drinkers via the AUDIT-C score (p > .05).

Post hoc summaries and comparisons of the key study variables by reported sex were conducted. Those summaries are presented in Tables 10–12. There were significant differences in year in school (p = .032) and class attendance in Fall 2020 (p = .041) between males and females, but otherwise there were no significant demographic differences between these two groups.

Females reported higher PROMIS Anxiety score (p < .001) and CAS score (p < .001) than males (see Table 9). There was no significant difference in MDMQ-R anxiety score, or percentage of time drinking to calm down (p > .05). Effect sizes (Cohen's d) for the differences were as follows: PROMIS Anxiety T score: .67, CAS score: .78, MDMQ-R Anxiety Subscale score: .19, Percentage of time drinking to calm down: .53.

Table 10

Sample Characteristics by Sex

	Total (N = 203)	Male (n = 85) n (%)	Female (n = 118)
Race/ethnicity			
White	162 (89.0)	77 (90.6%)	103 (87.3%)
Hispanic or Latino	15 (8.2)	8 (9.4%)	8 (6.8%)
Black or African American	5 (2.7)	2 (2.4%)	4 (3.4%)
Native American or American Indian	5 (2.7)	2 (2.4%)	3 (2.5%)
Asian/Pacific Islander	11 (6.0)	4 (4.7%)	8 (6.8%)
Marital status			
Single	143 (70.4%)	61 (71.8%)	82 (69.5%)
Married	57 (28.1%)	24 (28.2%)	33 (28.0%)
Divorced	2 (1.0%)	0 (0%)	2 (1.7%)
Year in school			
Freshman	7 (3.4%)	4 (4.7%)	3 (2.5%)
Sophomore	16 (7.9%)	4 (4.7%)	12 (10.2%)

Junior	14 (6.9%)	3 (3.5%)	11 (9.3%)
Senior	50 (24.6%)	20 (23.5%)	30 (25.4%)
Graduate student	77 (37.9%)	40 (47.1%)	37 (31.4%)
Enrollment type			
Full-time student	127 (62.6%)	56 (65.9%)	71 (60.2%)
Part-time student	32 (15.8%)	12 (14.1%)	20 (16.9%)
Class attendance Fall 2020			
Online	64 (31.5%)	23 (27.1%)	41 (34.7%)
Hybrid (combination in-person and online)	80 (39.4%)	38 (44.7%)	42 (35.6%)
Other	18 (8.8%)	9 (10.6%)	9 (7.6%)
Living situation			
On-campus	18 (8.9%)	6 (7.1%)	12 (10.2%)
Off-campus	142 (70.0%)	63 (74.1%)	79 (66.9%)
Employment status			
Full time (≥ 40 hours weekly)	71 (35.0%)	26 (30.6%)	45 (38.1%)
Part time (< 40 hours weekly)	62 (30.5%)	24 (28.2%)	38 (32.2%)
Unemployed	64 (31.5%)	34 (40.0%)	30 (25.25)
Estimated total household income 2019–2020			
< $30,000	61 (30.0%)	26 (30.6%)	35 (29.7%)
$30,000 - $40,000	29 (14.3%)	12 (14.1%)	17 (14.4%)
$40,000 - $60,000	29 (14.3%)	16 (18.8%)	13 (11.0%)
$60,000 - $80,000	19 (9.4%)	6 (7.1%)	13 (11.0%)
$80,000 - $100,000	11 (5.4%)	4 (4.7%)	7 (5.9%)
$100,000 - $150,000	21 (01.3%)	9 (10.6%)	12 (10.2%)
$150,000 - $200,000	12 (5.9%(	6 (7.1%)	6 (5.1%)
> $200,000	12 (5.9%)	4 (4.7%)	8 (6.8%)
		Mean (*SD*)	
	Total (*N* = 177)	Male (*n* = 77)	Female (*n* = 100)
Age (years)	25.2 (3.4)	25.4 (3.2)	25.1 (3.5)

Table 11

Summary of Participant Alcohol Use Patterns by Sex (N = 182)

Participant Alcohol Use	Total	Male	Female	*p*
		Median [IQR]		
Number of days per week Drinking reported on AIQ	3.0 [2.0 – 4.0] (*n* = 142)	3.3 [2.0 – 5.0] (*n* = 67)	3.0 [1.0 – 4.0] (*n* = 75)	.135
Number of days drank in past 7 days reported on TLFB-7	3.0 [2.0 – 5.0] (*n*= 129)	3.0 [3.0 – 6.0] (n=57)	3.0 [1.0 – 1.8] (n=72)	.040
Number of drinks consumed per occasion reported on AIQ	3.0 [2.0 – 4.0] (*n* = 141)	3.0 [2.0 – 4.0] (*n* = 66)	3.0 [2.0 – 4.0] (*n* = 75)	.927
Average number of drinks consumed per occasion reported on TLFB-7	1.4 [0.57 – 2.4] (*n* = 124)	1.4 [0.7 – 2.8] (*n* = 54)	1.1 [0.3 – 2.1] (*n* = 54)	.030

Total number of drinks consumed in past 7 days reported on TLFB-7	9.5 [4.0 – 16.8] (*n* = 124)	10.0 [4.8 – 19.8] (*n* = 54)	8.0 [2.0 – 15.0] (*n* = 70)	.030
Number of binge episodes[1] in the past 7 days reported on AIQ	0.0 [0.0 – 1.0] (*n* = 142)	0.0 [0.0 – 1.0] (*n* = 67)	0.0 [0.0 – 1.0] (*n* = 67)	.840
Number of binge episodes[1] in the past 7 days reported on TLFB-7	0.0 [0.0 – 1.0] (*n* = 129)	0.0 [0.0 – 1.0] (*n* = 57)	0.0 [0.0 – 2.0] (*n* = 72)	.343
Average number of drinks consumed during binge episode[1] reported on TLFB-7	6.5 [4.7 – 7.5] (*n* = 54)	6.9 [6.0 – 9.9] (*n* = 22)	5.0 [4.3 – 6.5] (*n* = 32)	< .001
Maximum number of drinks consumed on any occasion during the past 30 days reported on AIQ	6.0 [4.0 – 10.0] (*n*=141)	7.0 [5.0 – 10.0] (*n*=67)	6.0 [4.0 – 8.25] (*n*=74)	.022
Number of binge episodes in past 30 days[1] reported on AIQ	4.3 [1.0 – 5.0] (*n* = 142)	2.0 [1.0 – 5.0] (*n* = 67)	2.0 [1.0 – 4.0] (*n* = 75)	.663
Number of blackouts in past month[2] reported on AIQ	0.0 [0.0 – 1.0] (*n* = 87)	0.0 [0.0 – 1.0] (*n* = 42)	0.0 [00 – 1.0] (*n* = 45)	.506
AUDIT	8.5 [5.0 – 14.0] (*n* = 182)	9.5 [7.0 – 14.0] (*n* = 80)	7.0 [3.8 – 13.3] (*n* = 102)	.022
AUDIT – C	5.0 [4.0 – 7.0] (*n* = 182)	6.0 [4.0 – 8.0] (*n* = 80)	5.0 [3.0 – 7.0] (*n* = 102)	< .001
		N (%)		
Reported binge drinking episode[1] in the past 7 days on TLFB-7				.505
Yes	54 (29.7%)	22 (27.5%)	32 (31.4%)	
No	75 (41.2%)	35 (43.8%)	40 (39.2%)	
Family history of alcohol abuse				.201
Yes	70 (34.5%)	27 (31.8%)	43 (36.4%)	
No	86 (42.4%)	42 (49.4%)	44 (37.3%)	
History of blackout[3]				.744
Yes	87 (42.9%)	42 (49.4%)	45 (38.1%)	
No	55 (27.1%)	25 (29.4%)	30 (25.4%)	
Participated in drinking games				.080
Yes	104 (51.2%)	54 (63.5%)	50 (42.4%)	
No	37 (18.2%)	13 (15.3%)	24 (20.3%)	

[1]: binge episode is defined as having more than 4-5 drinks in a single occasion; [2] based on total AUDIT score (abstainer: AUDIT score=0; low risk consumption: AUDIT score=1 – 7; hazardous or harmful consumption: AUDIT score=8 – 14; likely alcohol dependence: AUDIT score≥15); [3]: blackout is defined as amnesia or memory loss for all or part of a drinking episode

Table 12

Descriptive Statistical Summary of Key Study Variables by Sex

	Total	Male	Female	*p* value	Cohen's *d*
	Mean (*SD*)				
PROMIS Anxiety T score[1]	63.2 (8.2)	60.6 (9.0)	65.3 (6.9)	<.001	.67
	Median [IQR]				
Coronavirus Anxiety Scale score[2]	6.0 [5.0 – 10.0]	5.0 [5.0 – 7.0]	8.0 [5.0 – 11.0]	<.001	.78
MDMQ-R Anxiety Subscale score	2.5 [1.7 – 3.5]	2.3 [1.8 – 3.3]	2.5 [1.5 – 3.5]	.789	.19
Percent of time drinking to calm down	15.0 [1.0 – 50.0]	10.0 [5.0 – 35.0]	20.0 [0.0 – 75.0]	.115	.53

1: Mean PROMIS Anxiety score in United States = 50; SD = 10; 2Coronavirus Anxiety Scale score ≥ 9 indicates probable dysfunctional coronavirus-related anxiety.

CHAPTER 5

DISCUSSION

Summary of Findings

In this study, we focused on factors such as anxiety, drinking to cope with anxiety, and alcohol self medication with recent hazardous or binge drinking among young adults after the onset of the COVID-19 pandemic. There were several novel:

1a. Higher anxiety (PROMIS Anxiety score) was positively associated with alcohol drinking quantity and frequency (USAUDIT, USAUDIT-C, and alcohol use frequency and alcohol use intensity items from the AIQ) in young adults.

1b. Higher COVID-19 anxiety (CAS) was positively associated with alcohol drinking quantity and frequency (USAUDIT, USAUDIT-C, and alcohol use frequency and alcohol use intensity items from the AIQ) in young adults.

2a. Drinking to cope with anxiety symptoms (MDMQ-R Anxiety Subscale score) mediated the relationship between anxiety (PROMIS Anxiety score) and alcohol drinking quantity and frequency (USAUDIT and USAUDIT-C) in young adults.

2b. Drinking to cope with anxiety symptoms (MDMQ-R Anxiety Subscale score) mediated the relationship between COVID-19 anxiety (CAS) and alcohol drinking quantity and frequency (USAUDIT and USAUDIT-C) in young adults.

3a. Alcohol self-medication (modified NESARC survey item) mediated the relationship between anxiety (the PROMIS Anxiety score) and alcohol drinking quantity and frequency (USAUDIT and USAUDIT-C) in young adults.

3b. Alcohol self-medication (modified NESARC survey item) mediated the relationship between COVID-19 anxiety (CAS) and alcohol drinking quantity and frequency (USAUDIT and USAUDIT-C) in young adults.

Significant positive bivariate associations were also found between nearly all primary concepts of interest including anxiety, coronavirus anxiety, drinking to cope with anxiety, alcohol self-medication, and alcohol quantity and frequency with the exception of the relationship between coronavirus anxiety and AUDIT-C score. Positive bivariate associations were also found between the number of binge episodes in the 30 days and anxiety and coronavirus anxiety, indicating as anxiety and coronavirus anxiety were higher, the number of binge episodes in the last 30 days was higher.

While we did not intend to evaluate sex differences in young adult anxiety and alcohol use, females reported higher anxiety and COVID-19 anxiety than males. There was no significant differences in reported drinking to cope with anxiety nor frequency of alcohol self-medication between males and females.

Relationship of Findings to Previous Research

Anxiety and Alcohol Use

Similar to other investigators, our results support the significant positive association between anxiety and alcohol use in young adults (Cranford et al., 2009; Dyer et al., 2019; Wemm et al., 2018). Similar to Cranford et al. (2009) and Wemm et al. (2018), which found higher binge drinking with generalized anxiety symptoms (measured by the Patient Health Questionnaire anxiety module and Beck Anxiety Inventory, respectively), the present study found higher anxiety symptoms (PROMIS Anxiety) were associated with increased binge drinking and higher alcohol quantity and frequency. Of note, however, both Cranford et al.

(2009) and Wemm et al. (2018) assessed frequency of binge drinking over the past 2 weeks where the present study used the AUDIT to assess hazardous drinking and measured frequency and intensity of drinking over the past 30 days using items from the AIQ.

Dissimilarities between the present study findings and previous studies that did not find a positive association between anxiety and alcohol use may be explained by methodologic differences (Cranford et al., 2009; Dawson et al., 2005). For example, Dawson et al.'s (2005) study used a single nominal yes/no item to assess for history of binge drinking. Conversely, the present study used the validated USAUDIT to corroborate the measurement of alcohol use quantity and frequency and to detect high risk alcohol use (Piano et al., 2015, 2017). Previous research also focused primarily on diagnosed anxiety disorders where we measured anxiety symptoms which could further explain differences in study results. For example, Dawson et al. (2005) measured anxiety disorders by participant self-report of previously diagnosed DSM-IV anxiety disorders and Mohamed and Ajamal (2015) used the World Health Organization Composite International Diagnostic Interview to measure for the presence of generalized anxiety disorder in the past 12 months. The present study, however, used the PROMIS Anxiety score to measure anxiety symptoms in the past seven days that may have not met the diagnostic threshold for an anxiety disorder in the DSM-IV or the World Health Organization Composite International Diagnostic Interview, but nonetheless could impact individuals' alcohol consumption.

Coronavirus Anxiety and Alcohol Use

There has been conflicting evidence about the relationship between anxiety and alcohol use during the COVID-19 pandemic; while several studies have found a positive association between anxiety and alcohol use during the COVID-19 pandemic (Lechner et al., 2020; Neill et

al., 2020; Sallie et al., 2020; Verma & Mishra, 2020), others have not (Jacob et al., 2021). Nearly all studies that evaluated the association between anxiety and alcohol use during the COVID-19 pandemic, however, did not evaluate if participants' anxiety was specifically surrounding the COVID-19 pandemic (Jacob et al., 2021; Lechner et al., 2020; Neill et al., 2020; Sallie et al., 2020; Verma & Mishra, 2020).

The present study, conversely, focused specifically on coronavirus-related anxiety symptoms and used the CAS to measure this unique concept in addition to the PROMIS Anxiety score to measure more generalized anxiety symptoms. As a result, we not only provide further evidence of the significant positive association between symptoms of anxiety and alcohol use in young adults during the COVID-19 pandemic, but it also demonstrates the significant positive association between coronavirus-specific anxiety and alcohol use in young adults.

The present study also replicates the findings of Rodgriguez et al. which found that COVID-19 stressors were associated with greater maximum number of drinks consumed, drinks consumed on a typical occasion, and number of drinking days in the past month (2020). The mean age of participants in this study, however, was 41.7 years (Rodriguez et al., 2020). By evaluating coronavirus anxiety in a young adult population, the present study expands on the existing literature and suggests the positive association between coronavirus anxiety and alcohol consumption throughout adulthood.

Finally, unlike Graupensperger et al. (2021) who found a nonsignificant decline in anxiety coping motives pre and post COVID-19 pandemic, the present study found that drinking to cope with anxiety mediated the relationship between anxiety and alcohol use and the association between COVID-19 anxiety and alcohol use.

Drinking to Cope

With the results of the present study, we added to the significant existing literature supporting the positive association between drinking to cope and alcohol use frequency and quantity (Grant et al., 2009; Ham et al., 2009; Wemm et al., 2018). Similar to Wemm et al. (2018) and Grant et al. (2009), the present study found a positive association between drinking to calm down and alcohol use quantity and frequency. The present study also replicated Ham et al.'s (2009) and Grant et al.'s (2009) studies, which identified the mediating effect of drinking to cope with anxiety on the association between anxiety and alcohol use in young adults.

The majority of studies examining the relationship between drinking to cope and young adult alcohol use prior to the present study used the four-factor Drinking Motives Questionnaire – Revised (DMQ-R), which measures drinking to cope with feelings of both depression and anxiety (Bravo & Pearson, 2017; Grant et al., 2007; Nehlin & Öster, 2019). Conversely, the present study used the MDMQ-R to measure drinking to cope which has both a coping-anxiety subscale and a coping-depression subscale. By using the MDMQ-R rather than the DMQ-R, we added to the existing literature by measuring drinking to cope with anxiety specifically, and not anxiety and depression. This improves the confidence it is in fact drinking to cope with anxiety rather than drinking to cope with depression that is mediating the relationship between anxiety and alcohol use.

Grant et al. (2009) was the single existing study found that used the MDMQ-R to measure drinking to cope with anxiety. Unlike the present study, which measured the frequency of binge drinking episodes over the past 30 days and hazardous alcohol use (using the AUDIT and items from the AIQ), Grant et al. (2009) measured average daily alcohol consumption (participants reported previous day's alcohol consumption for 21 days and the mean number of

drinks was calculated at the end of 21 days) and alcohol-related problems (measured using the Rutgers Alcohol Problem Index).

Prior to the present study, there had been no studies of the association between generalized anxiety and alcohol use during the COVID-19 pandemic, nor the association between coronavirus and alcohol use that have evaluated the impact of drinking to cope with anxiety on these associations (Jacob et al., 2021; Lechner et al., 2020; Neill et al., 2020; Rodriguez et al., 2020; Sallie et al., 2020; Verma & Mishra, 2020). The present study is believed to be the first to evaluate the association between anxiety, coronavirus anxiety, drinking to cope with anxiety, and alcohol use in young adults during the COVID-19 pandemic. As a result, while longitudinal studies are warranted to determine causal relationships, we are the first to suggest young adults may be drinking alcohol to cope with their anxiety during the COVID-19 pandemic and to cope with their anxiety about the coronavirus.

Alcohol Self-Medication

In alignment with existing literature, the present study showed a positive univariate association among alcohol self-medication and alcohol use (J. M. Bolton et al., 2009; Menary et al., 2011; J. Robinson et al., 2011; Turner et al., 2018). The findings of the present study differ from the existing literature in several ways. First, the present study is the first study in over 15 years to evaluate the association between alcohol self medication and alcohol use as previous studies were primarily based on NESARC and NCS data, which were collected between 1990–1992 and 2001–2005, respectively (J. Bolton et al., 2006; Crum et al., 2013). Therefore, any disparities in findings between previous literature and the present study may be accounted for by the changes in young adult drinking patterns noted over this period of time. It is also important to note the present study assessed anxiety symptoms while previous literature used the diagnosis of

DSM-IV anxiety disorders to measure anxiety. Therefore, stronger effect sizes noted in the present study may be attributable to the present study capturing subthreshold anxiety symptoms that may not have been detected in previous studies.

The findings of the present study add to the existing literature by examining the association between frequency of alcohol self-medicating (defined in this study as percent of time drinking to calm down). In this study, we are the first to assess the frequency of alcohol self-medication, thereby, addressing a previous gap in the literature. Finally, we addressed an existing gap in the literature by evaluating the role of alcohol self-medication in mediating the association between anxiety and alcohol use during the COVID-19 pandemic and the association between coronavirus anxiety and alcohol use.

Limitations

There are several limitations to the study. The first is the cross-sectional design of this study as it prevents causal inference and limits our ability to determine the directionality of the relationship among anxiety, COVID-19 anxiety, drinking motives, alcohol self-medication, and alcohol use.

The external validity of this study was an additional limitation. Participants were recruited from two universities in the Nashville, Tennessee area and therefore may not be representative of young adults elsewhere. While social media (Facebook and Instagram) ads were used for study recruitment, which may have improved the geographic reach of the study, the ads were targeted to the Nashville metro area and to those 18 to 30 years whose social media profiles demonstrated a connection to the universities. Similarly, the majority of participants were graduate students (37.9%, $n = 77$) or seniors (24.6%, $n = 50$) with a mean age of 25.2 ($SD = 3.4$), which suggests the results may be not be as representative of undergraduate students.

Finally, the majority of participants were White (88.7%, n = 180) and, therefore, the findings may not be representative of their peers with differing racial and ethnic identities.

The measurement of "drinking to cope with anxiety" and "alcohol self-medication" are also limitations of this study. Although the MDMQ-R coping-anxiety scale has demonstrated strong psychometric properties, it has not been widely used in the literature. As a result, further research is required for improved scoring interpretation. The alcohol self-medication item used in this study also requires further research to evaluate its psychometric properties. This item did not include a time frame (e.g., "In the last 30 days") ,which may have impacted how participants interpreted the item. While this is in alignment with items used in large epidemiologic studies such as the NESARC item it was based on, further evaluation of its psychometric properties is indicated.

Another limitation of this study that of the 182 participants included in the final analysis, 23 participants did not report their age. As a result, age was imputed for 23 participants in the final sample. Recognizing age is a significant predictor of alcohol use quantity and frequency, this may have impacted the effect size of the associations between anxiety and alcohol use found in this study.

Finally, the study does not control for depressive symptoms or peer alcohol use (including participation in a college fraternity or sorority), which have been shown to be associated with college student alcohol use and binge drinking (Krieger et al., 2018). As a result, relationship between this study's key variables may be attenuated when controlling for depressive symptoms and peer alcohol use.

Implications for Practice

We found a significant positive relationship between anxiety and alcohol use. Although this was a cross-sectional study, and causal inferences cannot be made at this time, it may be hypothesized based on these findings that individuals' anxiety precedes their alcohol use and ultimately leads them to risky alcohol use. While further research is indicated, the observed relationship between anxiety and alcohol use noted in this study indicated the importance of screening both for alcohol use behaviors and anxiety early and often. If a patient does not report any behaviors indicating risky alcohol use, they may be experiencing symptoms of anxiety that may increase their likelihood of engaging in hazardous alcohol use including binge drinking in the future. Therefore, by screening for anxiety symptoms early, based on the results of this study it may be hypothesized treating present anxiety symptoms may prevent future hazardous drinking and binge drinking. Similarly, as the COVID-19 pandemic remains ongoing, this study highlights the importance of screening for and addressing COVID-related anxiety in clinic practice in hopes of decreasing hazardous alcohol use.

Implications for Research

Through this study, we added to the existing literature by providing evidence for the positive association between anxiety and alcohol drinking (quantity and frequency) and the positive association between coronavirus anxiety and alcohol drinking (quantity and frequency). We also provided evidence for the mediational effects of drinking to cope with anxiety symptoms and the alcohol self-medication on these associations. Though, additional research is required to further understand these associations.

Future research should be aimed at overcoming the methodologic limitations of this study. First, additional research is required to improve the external validity of the present study. For example, future research would benefit from including more participants who identify as

male, as more individuals who identify as females participated in the present study than individuals who identify as male. Similarly, future research should seek to recruit more Black, Hispanic or Latino, Native American, Asian, Pacific Islander, and other racial and ethnic groups that were not well represented in this study. Future research would also benefit from recruiting more individuals in their freshman, sophomore, and junior year of undergraduate education and their noncollege attending peers as the majority of participants in the present study were undergraduate seniors and graduate students.

Future research would also benefit from recruiting a larger sample of participants, thereby, improving confidence in statistical analyses. Finally, longitudinal studies are required to determine if there are causal relationships between anxiety, coronavirus anxiety, drinking to cope with anxiety, alcohol self-medication, and alcohol use (quantity and frequency) that cannot be determined at this time due to the cross-sectional nature of the present study.

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