Gender Differences in Trauma Exposure, PTSD, and Substance Use Relationships in a College Sample

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Abstract

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Objective: This study evaluated gender differences in the relationship between trauma exposure, PTSD, and substance use (alcohol use, drinking consequences, and marijuana use) in a large college sample. It also examined the role of trauma types and PTSD symptom clusters in predicting substance use within trauma-exposed participants. **Participants:** The sample was collected through a multi-site study and included 3,753 undergraduate students (61% female) from two west-coast colleges. **Methods:** Moderation and multivariate regression analyses were conducted using cross-sectional data from participants' self-report questionnaires. **Results:** There were significant gender-related differences and interactions between gender and trauma exposure/PTSD-status in rates of substance use, drinking consequences, and risky drinking behaviors. Furthermore, emotional numbing symptoms and physical assault were most strongly associated with increased drinking consequences and marijuana use. **Conclusion:** College campuses should work to implement preventative and treatment interventions for students most at risk for engaging in risky substance use and experiencing negative consequences.

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Introduction

Full-time college students between the ages of 18 and 22 are more likely than their same-age peers not enrolled full-time (i.e., part-time students or those not in college) to report past month alcohol use, heavy episodic or "binge" drinking (defined as having 4 or more drinks on the same occasion for females, and 5 or more drinks on the same occasion for males at least once in the past 30 days)[1], and drink heavily (defined as "binge" drinking on at least 5 days in the past 30 days)[1]. In addition, up to forty-three percent of college students and young adults report past-year use of marijuana[2]. It is also well known that college students are at high risk for trauma exposure[3–5] and the risk for victimization appears greater among individuals who use substances[6,7]. While epidemiological studies have generally demonstrated a stronger relationship between trauma exposure, PTSD, and substance use in women compared to men[8–10], higher rates of exposure to potentially traumatic events[4] and higher drinking rates among male college students[2,11] highlight the importance of investigating gender effects in the relationships between trauma exposure, PTSD, and substance abuse in college populations. Information regarding the extent to which existing models of PTSD and substance use differentially pertain to male and female trauma exposed college students is particularly valuable for designing and implementing widely applicable and effective interventions for PTSD and problem drinking across college populations.

Substance use among college students

While college students endorse the use of a wide range of substances[2], the most frequently reported substances are alcohol and marijuana. In 2019, the Monitoring the Future study

indicated approximately 77% of college students consumed alcohol and 43% of students reported past-year marijuana use[2]. For some college students, substance use is frequent, heavy, or both, with past-month prevalence reflecting "daily" (i.e., 20+ times per month) marijuana use by 5.9%, "daily" alcohol use by 2.0%, and 32.7% consuming five or more drinks in a row in the past two weeks[2]. Alcohol and marijuana use in college populations can be associated with a range of negative consequences from academic difficulties (e.g., missed classes and poor grades), increased risk for physical assaults and injuries, and legal complications[12–15].

College men have traditionally used alcohol and drugs at heavier levels than college women[1,2]. Results from the 2019 National Survey of Drug Use and Health demonstrated that among full-time college students between the ages of 18 and 22, more men than women reported past month marijuana use (22.6% to 19.9%)[1]. Among college students, almost two times as many men reported daily use of alcohol than women and nearly 1.5 times as many men reported daily marijuana use than women (3.0% versus 1.5% for alcohol; 7.2% versus 5.0% for marijuana)[2]. Furthermore, male students were more likely to engage in heavy episodic drinking than female students, with 34% of college men drinking five or more drinks at least once in the past two weeks and 31.8% of college women drinking four or more drinks in a row at least once in the past two weeks[2]. Not surprisingly then, male students are also more likely than female students to meet criteria for alcohol use disorder, as defined by the Diagnostic and Statistical Manual-IV[1].

Traumatic events and posttraumatic stress disorder

A substantial portion of college students report having experienced one or more potentially traumatic events (PTE; e.g., sexual assault/rape, serious accidents, military combat) during their lifetime. Studies demonstrate between 66% and 84% of college students reported experiencing at

least one lifetime PTE[3,4,16]. In addition, college women are more likely to report PTE than their male counterparts across types of traumatic events, with the exception of combat/warfare[17].

In addition to frequency and type of trauma, patterns of response to trauma also appear to differ between men and women. Estimates suggest approximately 9-15% of the general college student population meets diagnostic criteria for PTSD[16,18], with college women more likely to experience symptoms of PTSD than their male counterparts[4,17]. This finding is comparable with rates of PTSD in community samples where higher rates of PTSD are typically reported by women than men[4,8,19].

Trauma exposure, PTSD, and substance use

To date, several studies using college-aged populations that have examined the co-occurrence of PTSD and substance use have demonstrated a positive association between trauma exposure, PTSD symptoms, and current drug use. These studies have shown that students with trauma exposure and PTSD symptoms have a greater probability of engaging in risky drinking[20], tobacco use[21], prescription drug misuse[22], marijuana use[23], and having alcohol- and other drug-related consequences[16].

Similarly, across populations, PTSD, as well as trauma exposure itself, have been associated with a greater likelihood to use substances and to have more problematic use, highlighting the need to explore post-trauma function as it relates to patterns of substance use. For instance, across several studies, women with adult sexual victimization histories reported drinking more than those without victimization histories[24,25]. PTSD has also been associated with higher alcohol use, drinking consequences, and increased use of marijuana[26,27]. Comparably, for college students, those diagnosed with PTSD may drink to a higher level of intoxication than those without a PTSD diagnosis[28] without respect to gender. Furthermore, a study by Sartor and

colleagues[29] demonstrated that both trauma exposure and PTSD have each been shown to independently contribute to the risk of alcohol dependence in young adult women.

While links between trauma and substance use are evident, it is less clear whether trauma exposure and PTSD are differentially associated with substance use and resulting consequences among college-aged men and women. A recent study by Bremer-Landau and Caskie[30] demonstrated that while there was a positive association between traumatic events and PTSD symptoms for both male and female young adult participants, PTSD symptoms predicted alcohol use disorder symptoms at a later timepoint in male participants only. Furthermore, a study by Rehder and Bowen[31] found a moderating effect of gender on PTSD symptom severity and cannabis use, showing an increased probability of being a cannabis user as PTSD symptom severity increased for male students only. Given the relatively high rates of both trauma exposure and substance use in college settings, examining gender differences in college populations is important for enhancing prevention and intervention services. As alcohol and marijuana are the drugs most endorsed for both frequency and quantity of use by college students, it appears key to examine the use of these two specific drugs in relation to trauma.

The Present Study

Interrelationships between trauma exposure, PTSD, and substance use are established in the literature. However, few studies have examined whether these relationships differ for men and women. The primary aim of this research was to examine the relationship between PTSD, substance use, and consequences in both male and female college students, specifically focusing on potential gender differences in the relationship between these variables. Accordingly, we posed three hypotheses. First, we expected individuals with PTSD would have higher alcohol and marijuana use, negative consequences, and at-risk drinking than individuals with either no

trauma exposure or with trauma exposure but without PTSD. Secondly, we expected a significant main effect for gender, with men demonstrating higher substance use, negative consequences, and at-risk drinking regardless of trauma/PTSD-status when compared to women. Lastly, we hypothesized a moderating role of gender on trauma/PTSD-status and substance use and consequences, with females and males with PTSD reporting significantly higher alcohol and marijuana use, at-risk drinking, and negative consequences than trauma exposed women and men without PTSD and non-trauma exposed women and men, respectively.

In addition to the hypotheses above, we planned to conduct exploratory analyses to examine the role of gender, trauma type, and individual PTSD symptom clusters, as well as the interaction between gender and PTSD cluster scores on marijuana use, alcohol use, and alcohol-related consequences. Given findings that have associated specific PTSD symptom clusters[32,23,33] and trauma types[34] with differential substance use in community and college settings, these may serve as potential predictors of substance use and negative consequences.

Methods

Participants

The full sample included 3753 participants. Of these, participants with missing data on predictor variables (n = 3) and missing data on all outcome variables (n = 28) were excluded from analyses. This led to a sample of 3722 students included in the primary analysis. Participants were recruited from two west-coast campuses. Campus 1 (n = 1926) is a large, public research university with an undergraduate enrollment of more than 28,000 students. Campus 2 (n = 1795) is a private mid-size university with approximately 6,000 undergraduate students. Across all participants, 61.1% were female (n = 2276) and 38.7% were male (n = 1440), with ages ranging from 18-25 years (M = 19.9, SD = 1.36). About 57% percent of participants self-identified as

Caucasian (*n* = 2129), 19% as Asian (*n* = 691), 13% as Hispanic/Latino (*n* = 474), 3% as African American (*n* = 117), 2% as Native Hawaiian/Pacific Islander (*n* = 63), and 1% as Native American (*n* = 19). Eleven percent of participants identified as multiracial (*n* = 396).

Design and Procedure

During the beginning of the fall term, 7,000 students (3,500 per campus) were randomly selected from the registrar's lists and sent letters inviting their participation in a study examining alcohol use and related attitudes among college students. Students were provided with a survey link and a unique personal identification number for participation as well as a subsequent e-mail with a link to the survey. After entering a personal identification number and completing an Institutional Review Board-approved informed consent form, participants were routed to the survey. All measures and procedures were approved by the local Institutional Review Boards on both campuses, and we obtained a Federal Certificate of Confidentiality to further protect participants.

Measures

Substance Use. The Daily Drinking Questionnaire (DDQ[35,36]) was used to assess average drinking on each day of a typical week, estimated over the past month. Participants were provided with information regarding a standard drink, for use in all measures of alcohol consumption. Specifically, a drink was defined as a beverage that contained approximately one-half ounce of ethyl alcohol (ranging from 12 ounces of beer to 1 measured shot of hard alcohol). Students' responses were summed to form a typical drinks-per-week variable that was used in the analyses. Marijuana use was assessed by a single item that asked, "In the last thirty days, on how many days did you use any kind of marijuana or hashish?"

Rutgers Alcohol Problem Index (RAPI[37]). The RAPI was used as a measure of negative drinking consequences. Sample items include, "Not able to work or study for a test," "Caused shame or embarrassment," "Was told by a friend or neighbor to stop or cut down on drinking." The RAPI asks students to rate the frequency of occurrence of 23 items reflecting alcohol's impact on a range of consequences and social and health functioning over the past month plus an additional two items on drinking and driving. A sum score was used for analyses, as recommended by the original scale. The Cronbach's alpha indicated excellent internal consistency with an $\alpha = .96$.

Alcohol Use Disorders Identification Test. The AUDIT[38] is a 10-item self-report measure that was used as an indicator of hazardous drinking. The AUDIT score ranges from 0 to 40; a score of 6 or greater demonstrates 91% sensitivity and 60% specificity for detecting high-risk drinkers in a college sample[39]. In the current study, the AUDIT demonstrated good reliability (Cronbach's $\alpha = .84$).

Posttraumatic Stress Diagnostic Scale (PDS[40]). The PDS is a 49-item self-report measure designed to assist with the diagnosis of PTSD. The instrument assesses all DSM-IV diagnostic criteria including: a traumatic stressor; experiencing fear, helplessness, or horror; intrusive, avoidance, and hyperarousal symptoms; and duration and course of symptoms. A PTSD diagnosis is made only if the six DSM-IV criteria are endorsed. The scale has been found to have high internal consistency and to demonstrate acceptable convergent validity when compared with other measures of PTSD diagnosis and symptom severity[41,42]. For the purposes of this study, the PDS was used as a diagnostic indicator of PTSD. Although PTSD diagnostic criteria are based on a three-cluster model of PTSD symptoms (i.e., Criterion B = Intrusive Reexperiencing, Criterion C = Avoidance/Numbing, Criterion D = Hyperarousal), the most support exists for a

four factor model of symptoms with an intrusive symptom cluster, a hyperarousal cluster consisting of two symptoms (hypervigilance, exaggerated startle), a dysphoria cluster with numbing symptoms and the remaining Criterion D symptoms, and a behavioral avoidance cluster[43,44]. Therefore, we chose to use a 4-factor structure in evaluating relationships between PTSD symptoms and substance use.

Analytic Strategy

Descriptive statistics were conducted to summarize sample characteristics of the study and demographic variables. Bivariate associations between PTSD symptom severity, PTSD symptom clusters, alcohol consumption, alcohol consequences, and marijuana use frequency were assessed by gender and trauma/PTSD-status using an analysis of variance (ANOVA).

To examine the association between gender, trauma/PTSD-status on substance use and consequences, we conducted a zero-inflated negative binomial (ZINB) regression analysis estimated by maximum likelihood (R package "pscl"[45]). The zero-inflated negative binomial model was chosen because of the non-normal distribution and excessive zeros found in the outcome variables, alcohol use (skew = 2.67, 33% zeros), consequences (skew = 5.99, 49% zeros), and marijuana use (skew = 4.37, 79% zeros). Two sets of predictors were used in each model to simultaneously estimate count and logistic regressions. The first set was used to predict counts of alcohol use, marijuana use, and drinking consequences. Predictors included trauma/PTSD-status (no trauma: 0; trauma/no PTSD: 1; trauma/PTSD: 2), gender (male: 0; female: 1), and a two-way interaction (trauma/PTSD-status x gender) to examine the moderating role of gender on the association between trauma/PTSD-status and substance use and consequences. Alcohol consumption was controlled in the prediction of drinking consequences. The second set of predictors were used in the logistic portion of the model to predict zero-values

for non-marijuana and non-alcohol users based on participants' reported alcohol usage (0 = "I have never tried alcohol") and marijuana usage (0 = "I have never tried marijuana"). The logistic regression predicted the likelihood of an observation being a "true" zero (e.g., non-alcohol users will always report zero alcohol use days and zero drinking consequences). Model appropriateness was tested using the Vuong test[46] for ZINB and the likelihood ratio test for overdispersion. Exponentiated odds ratios (ORs) and incidence rate ratios (IRRs) were estimated from the logistic and count portion of the model, respectively.

To examine high-risk drinking as a function of gender and trauma/PTSD status, we conducted a standard logistic regression analysis using the AUDIT as our binary dependent measure of high-risk drinking. The predictor variables included: gender, trauma/PTSD-status, and a two-way interaction term between gender and trauma/PTSD-status. Predictor variables were tested a priori to verify there was no violation of the assumption of the linearity of the logit. In the analyses, males with no trauma exposure were used as the reference group (Gender = 0, Trauma/PTSD-status = 0). The binary dependent variable, alcohol use behavior, was defined by the AUDIT measure score, such that 1 was coded as *high-risk* (greater than score of 6 out of 10) and 0 was coded as *non-high-risk* (less than score of 6 out of 10). Adjusted odds ratios (AORs) are reported for the analyses.

In addition, we performed exploratory analyses utilizing a hierarchical multiple regression approach to evaluate gender, trauma type, and individual PTSD cluster scores as predictors of substance use and consequences. Using participants who endorsed exposure to at least one PTE, we conducted three multiple regression analyses (one for each outcome) to evaluate gender as a moderator of PTSD symptom cluster scores on substance use and drinking consequences, after controlling for age and trauma type. Participant age was entered at Step 1.

Gender was entered at Step 2, with males coded as zero. Trauma type (sexual assault, physical assault, and other trauma exposure) was entered at Step 3. For these analyses, trauma type refers to the trauma endorsed as the worst event by the participant. At Step 4, we entered mean centered scores for the four PTSD symptom clusters. At Step 5, we entered the interaction terms for gender by PTSD symptom cluster interactions. The same analytic strategy was used to examine predictors of marijuana use and drinking consequences, with alcohol consumption also being controlled in Step 1 for the prediction of alcohol-related drinking consequences.

Results

Descriptive Statistics

Of the full sample, 61% of students (n = 2257) reported exposure to at least one PTE, with students exposed to trauma reporting being exposed to an average of 2.11 PTEs (SD = 1.40). Among males, 22% (n = 812) reported experiencing at least one PTE in comparison to 39% (n = 1442) of females. Of students reporting any PTEs, 17% met criteria for PTSD (n = 379) as measured by the PDS. In this sample, there was no significant difference in rates of PTSD between men (15%) and women (18%), X^2 (1, 379) = 0.002, p = .97.

Across all participants, 81% of students reported endorsing any alcohol use (n = 3018). Among those who endorsed alcohol, students reported consuming an average of 7.45 (SD = 8.97) drinks per week. Across the entire sample, 75% of students reported drinking alcohol over the past month (n = 2804) and 51% reported having consumed alcohol at least twice per week (n = 1886). Regarding hazardous drinking, the mean AUDIT score was 4.25 (SD = 3.83) among students that endorsed drinking, with 31% of participants (n = 945) reporting having at least monthly “binge” episodes. In addition, students who endorsed drinking averaged 3.14 (SD = 5.47) alcohol-related consequences in the last 30 days. The prevalence of “high-risk” alcohol

consumption was 38% (n = 1138). More specifically, in the male subsample, the prevalence of high-risk drinking was 47% (n = 539 out of 1141) and 32% (n = 596 out of 1871) in the female subsample. There were no significant differences in rates of high-risk drinking between men and women, X^2 (1, 1138) = 0.03, p = .86.

Forty eight percent of the sample endorsed having tried marijuana (n = 1707). Among those who endorsed marijuana use, 56% reported having tried marijuana but not having used in the past month (n = 958), and 20% of the sample (n = 745) reported using marijuana over the past month. Means and standard deviations for PTSD symptom severity, alcohol use, and marijuana use by gender are listed in Table 1.

Relation of Gender and Trauma/PTSD-Status with Substance Use

Zero-inflated negative binomial models were chosen to examine the relationship between gender and trauma/PTSD-status on substance use and drinking consequences. The likelihood ratio test was significant for all three models, alcohol use, $\chi 2$ (6) = 2523.1, p < .001; consequences, $\chi 2$ (6) = 1569.3, p < .001; and marijuana use, $\chi 2$ (6) = 2137.2, p < .001, demonstrating that the full model was a better fit of the data in comparison to a model without predictors. The Vuong test[46] indicated that the ZINB model was a better fit over a standard negative binomial model for prediction of alcohol use, z = 30.64, p < .001, drinking consequences, z = 23.35, p < .0001, and marijuana use, z = 28.70, p < .001. Furthermore, the likelihood ratio test for overdispersion was significant for all three models, alcohol use, $\chi 2$ (1) = 9288.50, p < .001; consequences, $\chi 2$ (1) = 4445.40, p < .001; marijuana use, $\chi 2$ (1) = 3919.80, p < .001, demonstrating that the ZINB was a more appropriate model and a better fit of the data over a zero-inflated Poisson model.

As predicted, trauma/PTSD-status was a significant predictor for two of the three outcome variables, drinking consequences, $\chi 2$ (2) = 63.71, p < .001, and marijuana use, $\chi 2$ (2) =

7.44, $p = .02$. However, the hypothesis regarding alcohol use was not supported. Alcohol consumption did not differ significantly across the three trauma/PTSD-status groups, $\chi 2$ (2) = 1.15, $p = .56$. To examine group differences between the trauma/PTSD-status groups, we conducted pairwise comparisons for drinking consequences and marijuana use using Bonferroni correction for multiple comparisons. Comparison analyses indicated that the PTSD group reported higher drinking consequences than both the no trauma group ($B = 1.78$, $SE = .29$, $IRR = 5.94$, $p < .001$) and the trauma only group ($B = 1.72$, $SE = .29$, $IRR = 5.57$, $p < .001$), indicating that expected number of drinking consequences for students with PTSD were 5.57 and 5.94 times the expected number of consequences for students with trauma, but no PTSD and students with no trauma, respectively. There were no significant differences between the PTSD group and the no trauma group ($B = -.16$, $SE = .08$, $p = .17$) or trauma only group ($B = -.16$, $SE = .08$, $p = .17$) for marijuana use. Furthermore, we found no differences in drinking consequences ($B = .06$, $SE = .11$, $p = 1.00$) or marijuana use ($B = -.003$, $SE = .04$, $p = 1.00$) between the trauma only and no trauma group.

Gender was also a significant predictor for two of the three dependent variables, alcohol use, $\chi 2$ (1) = 301.96, $p < .001$, and marijuana use, $\chi 2$ (1) = 48.97, $p < .001$. As predicted, males reported consistently higher alcohol use ($B = 4.85$, $SE = .42$, $IRR = 127.74$, $p < .001$) and marijuana use ($B = .27$, $SE = .06$, $IRR = 1.30$, $p < .001$) than did females. There were no significant differences between males and females for negative drinking consequences ($B = .02$, $SE = .20$, $p = .93$).

The interaction between gender and trauma/PTSD-status was a significant predictor for negative drinking consequences, $\chi 2$ (2) = 6.86, $p = .03$, as hypothesized (Figure 1). Results indicated that men who met criteria for PTSD experienced more drinking consequences than

men with trauma exposure (*B* = 2.13, *SE* = .46, *IRR* = 8.4, *p* < .001) and men with no trauma exposure (*B* = 1.94, *SE* = .47, *IRR* = 6.93, *p* = .001). Similarly, women who meet criteria for PTSD also reported significantly more alcohol-related consequences than women with trauma only (*B* = 1.31, *SE* = .33, *IRR* = 3.71, *p* = < .001) and women with no trauma (*B* = 1.63, *SE* = .34, *IRR* = 5.09, *p* < .001), as hypothesized. Surprisingly, women with trauma exposure only also reported significantly more negative drinking consequences than women who reported no trauma (*B* = .32, *SE* = .15, *IRR* = 1.38, *p* = .03). While there were no significant differences between male and female participants with PTSD, male participants with trauma exposure reported significantly more alcohol-related consequences than females with trauma exposure (*B* = .43, *SE* = .15, *p* = .005). Interaction terms were not significant for alcohol consumption, $\chi 2$ (2) = 2.43, *p* = .30, nor marijuana use, $\chi 2$ (2) = .32, *p* = .85.

The logistic portion of the model demonstrated that reported alcohol use was significantly related to the odds of being an "always zero" for alcohol use days (*OR* = .01, *z* = -16.19, *p* < .001) and number of drinking consequences (*OR* = .03, *z* = -14.71, *p* < .001). Similarly, reported marijuana usage was significantly related to the odds of being a "true" zero for marijuana use days (*OR* = 0.01, *z* = -15.21, *p* < .001).

Risky Drinking as a Function of Gender and Trauma/PTSD-Status

A standard logistic regression analysis was conducted to identify factors that were associated with the presence of high-risk drinking as defined by the AUDIT. The full model containing all the predictors was found to be statistically significant, X^2 (5, 3610) = 62.24, *p* < .001, indicating that the model was able to distinguish between participants who were risky or non-risky drinkers, with a 68% accuracy of correctly predicting high-risk alcohol users. The McFadden's R^2 was .01.

The results indicated that gender, $LR\ X^2\ (1) = 54.93$, $p < .001$, and trauma/PTSD-status, $LR\ X^2\ (2) = 10.14$, $p = <.001$, contributed significantly to the prediction of high-risk status. To further examine these group differences, simple effects coefficients were computed for gender and trauma/PTSD-status using Bonferroni correction for multiple comparisons. When controlling for trauma/PTSD-status, the odds of males being high-risk drinkers was 1.72 times higher than the odds of female students being high-risk drinkers, $AOR = 1.72$, $z = 5.93$, $p <.001$. Thus, males had a higher risk of engaging in risky alcohol consumption, as predicted. In addition, individuals with PTSD had greater odds of being risky drinkers when compared to individuals with no trauma exposure, $AOR = 1.46$, $z = 2.97$, $p = .009$, as expected. The gender by trauma/PTSD-status interaction term was not a significant predictor for risky alcohol use, $LR\ X^2\ (2) = .09$, $p = .96$.

Exploratory Analyses: Relationship of Trauma Type and PTSD Symptom Clusters to Substance Use

Hierarchical multiple regression analyses were conducted to examine the role of specific PTSD symptom clusters and trauma type as predictors of substance use and/or consequences of alcohol use, moderated by gender.

Alcohol Use. Gender, $\Delta R^2 = .05$, $F(1, 2095) = 101.31$, $p < .001$, and trauma type, $\Delta R^2 = .006$, $F(3, 2092) = 4.35$, $p = .005$, added significantly to the prediction of alcohol consumption. However, neither PTSD cluster scores, $F(4, 2088) = 1.32$, $p = .26$, nor their interactions with gender, $F(4, 2088) = 0.86$, $p = .49$, added significantly to the prediction of the model. In the final model gender, $\beta = -.22$, $t = -9.97$, $p < .001$, and sexual assault exposure, $\beta = 0.05$, $t = 2.15$, $p = .03$, were the only variables that predicted consumption, $R^2 = .06$, $F(13, 2084) = 9.78$, $p < .001$. More precisely, men reported consuming more alcohol than women and individuals who

reported having experienced a sexual assault consumed more alcohol than those reporting other categories of trauma type.

Drinking Consequences. Alcohol consumption, trauma type, PTSD cluster symptoms, and the PTSD by gender interactions all added significantly to the prediction of drinking consequences (Table 2). Gender did not add significantly to the model. In the final model, alcohol consumption, trauma type, PTSD cluster scores, and the gender by PTSD cluster scores interaction were all significant predictors of alcohol consequences, $R^2 = .25$, $F(14, 2074) = 51.37$, $p < .001$. Experiencing a sexual or physical assault or experiencing more emotional numbing symptoms were each associated with more alcohol-related negative consequences. The interaction between gender and intrusive cluster score was also found to be a significant predictor of drinking consequences. Results indicated that for males, there was a marginally significant trend for higher intrusive symptoms to be associated with higher alcohol consequences ($B = .31$, $t(2074) = 1.72$, $p = .08$). There were no significant differences found for female participants ($B = -.13$, $t(2074) = -1.10$, $p = .27$).

Marijuana Use. Gender, $\Delta R^2 = .01$, $F(1, 2083) = 30.41$, $p < .001$, trauma type, $\Delta R^2 = .01$, $F(3, 2080) = 7.66$, $p < .001$, and PTSD cluster scores, $\Delta R^2 = .01$, $F(4, 2076) = 4.03$, $p = .003$, all added significantly to the prediction of marijuana use. The interaction between gender and PTSD cluster scores was not significant, $F(4, 2072) = .74$, $p = .57$. In the final model gender, $\beta = -1.24$, $t = -5.34$, $p < .001$, physical assault, $\beta = .73$, $t = 2.93$, $p = .003$, other traumatic events, $\beta = -.81$, $t = -2.15$, $p = .03$, and numbing, $\beta = .12$, $t = 2.02$, $p = .04$, predicted frequency of marijuana use, $R^2 = .04$, $F(13, 2073) = 6.38$, $p < .001$. More specifically, being male, having experienced a physical assault, or experiencing more emotional numbing were all associated with using marijuana more frequently. Interestingly, experiencing other types of traumatic events was

associated with using marijuana less frequently.

Discussion

The current investigation examined the relationship between trauma exposure, PTSD, and substance use and consequences among college students, moderated by gender. Over half (63%) of a sample of college students reported past exposure to a potentially traumatic event, and 17% of these participants met criteria for PTSD, as assessed by the PDS[40]. This finding is consistent with previous studies examining the rates of trauma exposure and self-reported PTSD in college populations[3,17,47,5]. Consistent with our hypotheses, college students meeting criteria for PTSD reported more drinking consequences and had greater odds of engaging in high-risk drinking than other students. Additionally, as predicted, males reported more alcohol and marijuana use and had greater odds of being high-risk drinkers when compared to female students. There was also a significant interaction between gender and trauma exposure/PTSD-status on drinking consequences, suggesting a moderating effect of gender on the relationship between trauma exposure/PTSD and negative alcohol-related consequences. Regression analyses also indicated that those who experienced sexual assault reported more alcohol consumption and alcohol-related consequences, and those who experienced physical (non-sexual) assault reported more alcohol-related consequences and marijuana use. Finally, exploratory analyses indicated that experiencing emotional numbing symptoms was associated with more alcohol-related consequences and marijuana use.

Findings from the current study demonstrate that gender is predictive of substance use and drinking consequences. As demonstrated, males, regardless of trauma exposure, reported using more alcohol and marijuana and had greater odds of being risky drinkers than female participants. This finding is consistent with previous literature in college samples that have found

higher rates of alcohol and marijuana use among male college students[2,48]. Findings also suggest that men and women with PTSD experienced more drinking consequences than men and women without PTSD, respectively. Furthermore, women with a history of PTEs that did not meet criteria for PTSD also experienced more drinking consequences than women with no PTE history, a finding that was not supported among male students. This suggests that among women, exposure to traumatic events alone may be predictive of future consequences associated with alcohol use.

Contrary to our hypotheses, there were no significant differences in alcohol use between students meeting criteria for PTSD and students who did not meet criteria. Results did demonstrate, however, individuals who met criteria for PTSD reported more negative drinking consequences, marijuana use, and had greater odds of being risky drinkers than individuals who did not meet PTSD criteria, across both male and female students. This is of particular importance considering previous studies have shown higher rates of revictimization among those that use substances, especially among women and those that engage in "binge" drinking[49], heavy episodic drinking[50], and marijuana use[51]. Thus, one concern is for trauma-exposed students and students meeting criteria for PTSD who are engaging in increased marijuana use or risky drinking as they may be more vulnerable to experiencing subsequent traumatic events.

In the current investigation, emotional numbing symptoms of PTSD were associated with more alcohol-related negative consequences and more frequent marijuana use. These findings can be considered consistent with the self-medication framework which suggests that alcohol and drug use develop to mitigate symptoms of pain, trauma, and/or mood-related problems[52–54]. As mental health continues to receive attention on college campuses, findings have shown that college students have a range of mental health problems[55,56] and several studies reflect the belief

that rates of mental health problems are increasing on college campuses[57,58]. Thus, while some studies have shown higher rates of service utilization among students who have experienced trauma[59], a focus of concern is that mental health services on college campuses continue to be underutilized and trauma-exposed students may not be receiving proper treatment, particularly to relieve symptoms of pain and trauma. If students choose, therefore, to "self-medicate" with drugs and alcohol, efforts to connect students who may be experiencing difficulties with clinical services are still of great importance. These could take the form of increased screening or even strategic outreach to students known to have experienced a potentially traumatic event[60].

Outside of a counseling setting, these findings also have implications for prevention or early intervention with students. With efficacious brief interventions already in place for alcohol and marijuana use[61–64], future studies should examine the specific impact of such interventions on students with trauma exposure and PTSD. Particularly, interventions that focus on addressing the context and function of the substance use may provide a more direct and effective intervention strategy for trauma-exposed individuals. Such brief interventions could also incorporate alcohol- and marijuana-related protective behavioral strategies or coping strategies that target both substance use and trauma-related symptoms[65]. Additionally, along with strategies to reduce drinking, a recent study by Stappenbeck and colleagues[66] incorporated emotional regulation skills in a brief web-based intervention that has showed initial efficacy for reducing drinking and PTSD symptoms in women with sexual assault histories, suggesting a potential benefit of incorporating emotional regulation strategies in interventions as well.

It is important to note that the temporal order of the relationship between PTSD and substance use may differ across participants. More specifically, in certain cases, PTSD may not result in increased risky substance use and negative consequences; but rather, substance use may

contribute to risk-taking, being in potentially dangerous situations, or otherwise increasing someone's likelihood of experiencing a trauma (e.g., physical or sexual assault). More detailed research could help illustrate potential subtypes of individuals representing not only potential trauma-related coping motives for drinking but further identify the role of temporal relationship between constructs and ways of identifying individuals with differing temporal patterns of use.

There are several limitations related to these findings. Marijuana use was assessed by a single item, and a more thorough and detailed assessment of students' use of marijuana and consequences associated with use would have afforded a more complex picture of the relationships between the variables assessed here. In addition, this sample utilized college students who, while not without struggles and challenges, likely represent a relatively healthy population. Therefore, results may not generalize outside of a college setting or to a clinical population with greater symptom severity and impairment. Although interesting relationships emerged in the exploratory analyses, only a small amount of the variance was accounted for. As such, these findings should be both replicated and further explored to determine the validity, impact, and the clinical utility of the relationships between the behaviors of interest. Furthermore, this study only assessed students who self-identified as female or male. Given findings that have reported higher rates of victimization among transgender and gender diverse college students[67,68], more work is needed to understand the impact of trauma exposure and PTSD on substance use and drug-related consequences within these populations on college campuses.

This study contributes valuable information regarding gender differences in the relationship between trauma exposure, PTSD, substance use, and alcohol-related negative consequences in college samples by including male and female students. Given the well-

documented risks of this developmental stage, a more detailed exploration of variables associated with problem alcohol and substance use are warranted. Identifying key predictors will inform the development of effective targeted interventions for college student populations that have the promise of identifying those most at risk for problem behaviors and reducing barriers to effective preventative programs and treatment interventions.

Figures and Tables

Table 1. Means and standard deviations for study variables by gender and trauma/PTSD-status.

	Men						**Women**					
	No Trauma (n = 653)		Trauma/No PTSD (n = 663)		Trauma/PTSD (n = 124)		No Trauma (n = 892)		Trauma/No PTSD (n = 1129)		Trauma/PTSD (n = 255)	
Variables	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
PTSD Symptom Severity	-	-	2.16	(3.48)	18.47[2]	(9.13)	-	-	3.09	(4.31)	18.77[2]	(8.26)
Intrusive Symptoms	-	-	0.68	(1.20)	3.59[2]	(1.41)	-	-	1.05	(1.41)	3.70[2]	(1.29)
Effortful Avoidance	-	-	0.24	(0.54)	1.61[2]	(0.66)	-	-	0.39	(0.66)	1.72[2]	(0.54)
Emotional Numbing	-	-	0.66	(1.25)	6.09[2]	(1.71)	-	-	0.75	(1.32)	5.81[2]	(1.84)
Hyperarousal	-	-	0.17	(0.49)	1.23[2]	(0.82)	-	-	0.28	(0.63)	1.44[2]	(0.80)
Alcohol Consumption	8.27	(11.53)	8.32	(10.96)	9.09	(11.94)	4.41	(5.75)	4.57	(5.55)	5.02	(7.20)
Alcohol Consequences	2.65	(5.67)	2.75	(4.58)	6.16[1,2]	(13.25)	1.96	(3.30)	2.29	(4.12)	3.60[1,2]	(6.41)
Days of Marijuana Use	2.10	(5.77)	2.16	(6.08)	3.39	(7.93)	0.74	(3.20)	0.95	(3.32)	1.65[1,2]	(4.96)

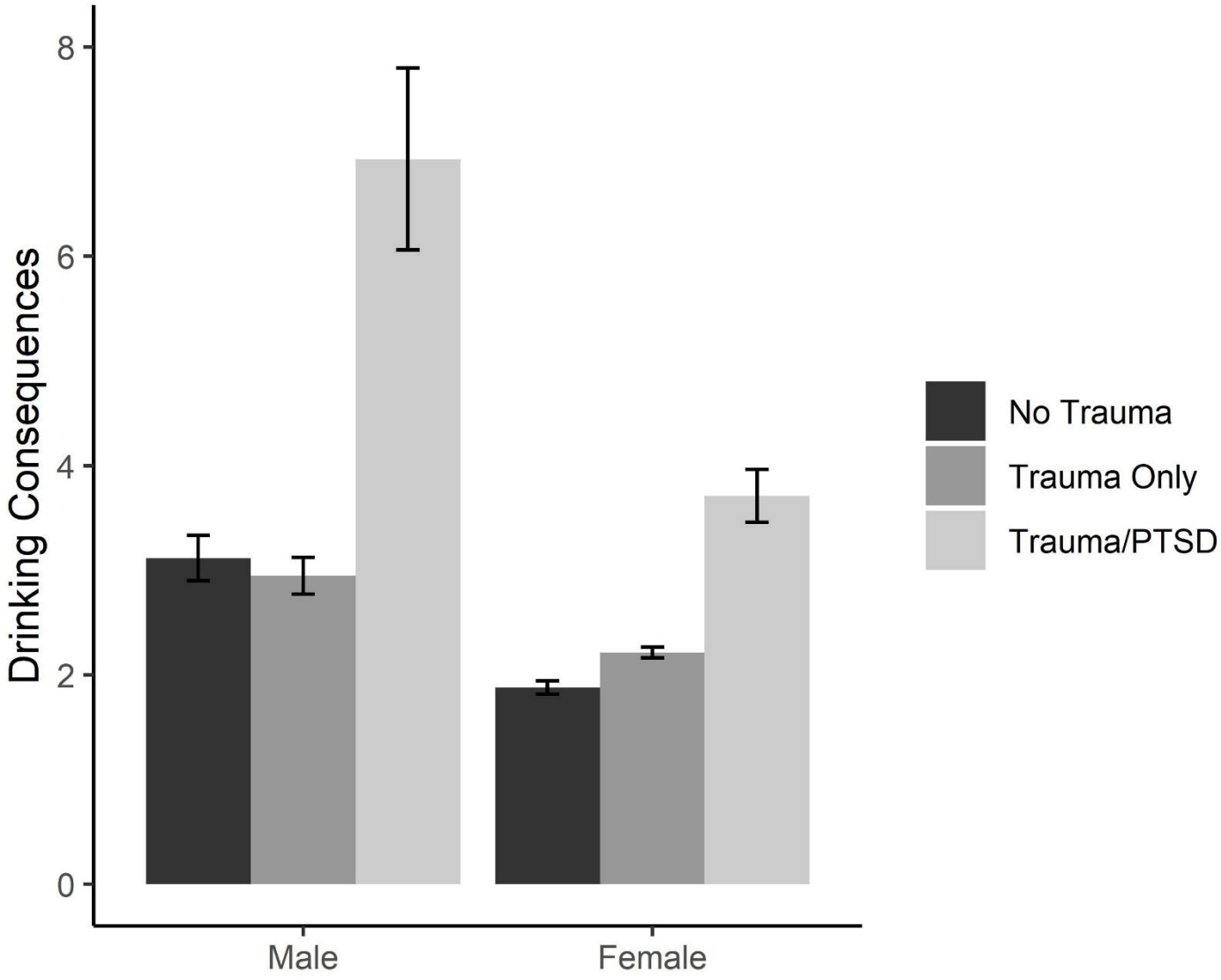
Note. One-way ANOVA analyses. [(1)] Significantly different from No Trauma group, $p < .05$; [(2)] significantly different from Trauma/No PTSD group, $p < .05$.

Table 2. Sequential regression analyses of gender, trauma type, and PTSD symptoms as predictors of alcohol-related consequences.

	B	***S.E.***	***β***	***R^2***	***ΔR^2***
Step 1: Control Variables				0.22	0.22 ***
Total Drinks	0.30	0.01	0.46 ***		
Age	0.14	0.08	0.03		
Step 2: Gender				0.22	0.001
Gender	0.40	0.23	0.03		
Step 3: Trauma Type				0.22	0.01 ***
Sexual Assault	1.05	0.27	0.08 ***		
Physical Assault	0.79	0.25	0.06 **		
Other Trauma Exposure	0.59	0.37	0.03		
Step 4: PTSD Symptoms				0.25	0.03 ***
Intrusive	0.02	0.10	0.006		
Effortful Avoidance	0.01	0.20	0.002		
Emotional Numbing	0.30	0.07	0.14 ***		
Hyperarousal	0.24	0.18	0.03		
Step 5: Gender x PTSD Symptoms				0.25	0.006 **
Gender x Intrusive	-0.44	0.22	-0.24 *		
Gender x Effortful Avoidance	0.39	0.43	0.10		
Gender x Emotional Numbing	-0.14	0.15	-0.11		
Gender x Hyperarousal	-0.23	0.40	-0.05		

Note. N = 2089. Unstandardized regression coefficients (B) and intercept, standard error of the regression (S.E.), standardized regression coefficients (β), adjusted R-squared, and p-values. *$p < .05$, ** $p < .01$, *** $p < .001$.

Figure 1. The moderating role of gender on the effect of trauma exposure/PTSD-status on drinking consequences.



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