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Alcohol Craving and Demand Mediate the Relation between Posttraumatic Stress Symptoms and Alcohol-Related Consequences

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Abstract

Objective—Posttraumatic stress (PTS) symptoms are associated with alcohol-related consequences, but there is a need to understand mediators that may help explain the reasons for this relationship. Individuals with PTS may experience elevated craving and alcohol reward value (demand), which may contribute to risk for alcohol-related consequences.

Method—We examined relationships between PTS status, craving, alcohol demand, and alcohol-related consequences in PTS-positive (n = 64) and PTS-negative (n = 200) college students (M age = 21.7; 77% women; 54% Caucasian; 34% African American) who endorsed past-month alcohol use. We tested craving and alcohol demand as mediators of the relation between PTS status and alcohol problems.

Results—Craving (B = .04, SE = .02, 95% CI = .01 – .10), demand intensity (B = .05, SE = .03, 95% CI = .0009 – .17), and demand elasticity (B = .05, SE = .03, 95% CI = .006 – .03) significantly mediated the association between PTS symptoms and alcohol problems. Craving remained a significant mediator in a multiple mediators model (B = .08, SE = .04, 95% CI = .03 – .19).

Conclusions—Craving and alcohol demand may partially explain the relation between PTS status and alcohol-related consequences. Craving may be especially salient for individuals with PTS symptoms, as it may lead to more severe alcohol-related consequences even in the absence of elevated alcohol consumption.

Keywords

Posttraumatic stress symptoms; craving; alcohol-related consequences; behavioral economics; alcohol demand

Alcohol misuse is a significant problem among college students. Approximately 44% of students report a heavy drinking episode (4/5 drinks in one occasion for women/men) in the past two weeks (Core Institute; CORE, 2012). Alcohol use in this age group is associated with motor vehicle accidents, risky sex, sexual assault, fights, and fatalities (Hingson et al.,

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2005). A large body of research has identified risk factors for college students' heavy alcohol use (Ham & Hope, 2003), and recent research indicates that students with symptoms of posttraumatic stress disorder (PTSD) may be at especially high risk (Read et al., 2012).

Traumatic events, which can lead to trauma-related symptoms (such as posttraumatic stress disorder, PTSD), are common among college students. In a recent sample of almost 1,000 undergraduate students, 74% endorsed at least one experience that involved life threat, threat of injury, or physical integrity that evoked fear, helplessness, or horror (Criterion A traumatic event; Read et al., 2012), and 15% reported some degree of PTSD symptoms of (i.e., reexperiencing, avoidance, numbing, and hypervigilance). Notably, in general adult samples, about one-third to one-half of individuals with a history of lifetime PTSD also have lifetime drug or alcohol dependence (Blanco et al., 2013; Kessler et al., 1995). Among college students specifically, substance use severity is elevated in individuals experiencing some posttraumatic stress symptoms (PTS; Read et al., 2012), even in the absence of full PTSD diagnosis. Individuals with either full PTSD or PTS reported significantly more alcohol-related consequences at the beginning of their first year of college, and these consequences steeply decreased within the first semester and leveled off throughout the year (Read et al., 2012). Another study, described in more detail below, also found that PTS were associated with elevated alcohol reward value (demand) among young adult college students (Murphy et al., 2013). Thus, in high-risk non-clinical samples such as college students, PTS may be an important risk factor for alcohol misuse. Numerous studies have found that individuals with trauma exposure may experience significant distress even in the absence of PTSD (Carlier & Gersons, 1995; Mylle & Maes, 2004), and it is important to understand the risks associated with trauma symptoms in individuals who may not have an official diagnosis.

Theoretical models of psychological distress and substance use suggest that in the face of posttraumatic stress symptoms, alcohol use often functions to ameliorate trauma-related negative affect and anxiety (Khantzian, 1997). Indeed, a large literature suggests that alcohol is often used in the service of dampening arousal and modulating mood (Simpson et al., 2012) and that this type of coping-motivated alcohol use is associated with more severe alcohol use outcomes (Fossos et al., 2011). Alcohol use may in fact become so instrumental to negative affect and anxiety reduction that, over time, posttraumatic stress symptoms may automatically induce urges to drink (Kaysen et al., 2014; Simpson, et al., 2012), and this may function to increase the reward value of alcohol among individuals experiencing PTS (Murphy et al., 2013). It is possible that dysregulated drinking patterns, characterized by heightened alcohol craving and elevated alcohol reward value, may account for the association between post trauma symptoms and alcohol-related consequences.

Post Trauma Symptoms and Craving

Craving for alcohol is defined as a desire or strong urge to drink (Kavanagh et al., 2013) and is often thought of as a temporary state associated with a distinct set of specific verbal, physiological, and behavioral responses (Tiffany & Conklin, 2000). Frequent and intense craving is associated with level of alcohol use and severity among young adult drinkers (Rosenberg & Mazzola, 2007) and is a diagnostic criterion of alcohol use disorder and

alcohol dependence in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM–5*; American Psychiatric Association, 2013) and the *International Statistical Classification of Diseases and Related Health Problems (ICD-10;* WHO, 1992), respectively.

Heightened craving may reflect an important mechanism by which PTS confers risk for alcohol use severity. Some PTS symptoms, such as reexperiencing and hypervigilance, are interoceptive signals that function as cues; they may produce craving, which in turn motivates risky alcohol consumption. Accordingly, PTS symptoms such as re-experiencing, hypervigilance, and numbing have predicted craving in both clinical and non-clinical samples (Coffey et al., 2010; Kaysen et al., 2014). Further, intrusive and behavioral avoidance symptoms of PTSD are associated with stronger urges to drink and higher likelihood of alcohol use on the same day (Kaysen et al., 2014). Thus, individuals with PTS symptoms may show higher levels of craving due to using alcohol to cope with distress, and craving may in turn lead to more problematic patterns of alcohol use. To our knowledge, craving has not been examined as a mediator of the relationship between PTS symptoms and alcohol-related consequences.

PTSD and Alcohol Demand

An additional or alternative mechanism that may link PTSD and alcohol outcomes is elevated alcohol reward value. Behavioral economic theories of addiction view substance use as operant choice behavior that is primarily maintained by the reinforcing properties of substances (Madden & Bickel, 2010). *Demand*, defined as the level of alcohol consumption and expenditures as a function of price, is a primary index of reward value that reflects the level of motivation or desire to consume a substance (Bickel et al., 2014). The Alcohol Purchase Task is a reliable and valid hypothetical demand curve measure (Amlung & MacKillop, in press) that allows researchers to conveniently measure demand across a range of drink prices. The present study examined several indices of the reward value of alcohol: intensity (drinks consumed at price = $0), breakpoint (first price that completely suppresses consumption), O_{max} (maximum alcohol expenditure), and elasticity (the sensitivity of alcohol consumption to increases in cost). Individuals with elevated alcohol demand report higher levels of alcohol-related consequences (Skidmore, Murphy, & Martens, 2014) and poor response to alcohol interventions (Dennhardt et al., 2014).

Aversive visceral states such as stress or craving may increase the reward value of a substance. Indeed, laboratory studies suggest that acute craving (Amlung et al., 2015; MacKillop et al., 2010) or stress (Rousseau, Irons, & Correia, 2011) manipulations increase demand. Another laboratory study in which participants were administered alcohol suggested that induced stress may increase both alcohol demand and subjective craving (Amlung & MacKillop, 2014). Trait measures of craving also show positive associations with trait levels of demand (MacKillop et al., 2010). In addition to the positively reinforcing properties of the substance, an individual who is experiencing an aversive visceral state such as stress or craving will benefit from an immediate reduction in this state following ingestion of the substance (negative reinforcement), thereby increasing the net value of the substance. With respect to PTS specifically, alcohol may act as a depressant for

hyperarousal symptoms and may help individuals avoid distressing memories or feelings associated with the traumatic event, thereby increasing demand. PTS symptoms might also increase avoidance and reduce engagement in rewarding activities. Reduced engagement in alternatives resulting from PTS would likely increase the rewarding value of alcohol in a manner that might be independent from craving.

Murphy et al. (2013) examined the associations between PTS symptoms and alcohol demand in heavy drinkers. They found that PTS symptom level was associated with greater peak consumption and expenditure, and less price sensitivity, after accounting for typical drinking level and demographic variables (e.g., sex, ethnicity). Although Murphy and colleagues did not address relations between PTS symptoms, elevated demand, and levels of alcohol-related consequences, it is possible that PTS symptoms are associated with a reduced ability to effectively modulate drinking patterns, higher drinking rates, and more alcohol-related consequences. Individuals with PTS symptoms may consume large amounts of alcohol when it is inexpensive or free and may be less sensitive to price increases due to heightened need for the immediate anxiolytic effects of alcohol. This may, in part, account for the association between PTS symptoms and alcohol-related consequences.

Present Study

The current study sought to replicate and extend prior work by examining PTS, alcohol-related consequences, craving, and demand for alcohol in a large sample of undergraduate college students with a wide range of drinking levels. In order to elucidate possible mechanisms underlying the relations between PTS status and alcohol-related consequences and to further knowledge of the link between the two, we examined craving and alcohol demand as mediators of the relationship between PTS status and alcohol-related consequences. Notably, we distinguish PTS from the formal diagnosis of PTSD, as participants completed only a screener of PTSD rather than a diagnostic interview, and previous research suggests that the presence of PTS may be an important risk factor for alcohol misuse in non-clinical but high-risk samples. We hypothesized that PTS status would show significant associations with alcohol craving, alcohol demand, and alcohol-related consequences, and that craving and demand would significantly mediate the relation between PTS status and alcohol-related consequences. Support for these hypotheses would extend theoretical models linking PTS with alcohol misuse and potentially inform the development of treatments for alcohol misuse among individuals exposed to trauma.

Method

Participants and Procedure

Participants were 264 undergraduate college students recruited from psychology courses (77% women; average age = 21.7, *SD* = 5.0, range = 18–38) at a large public university in the southeastern United States. Consistent with the student demographic characteristics at our university, which serves many non-traditional students, 41 (16%) of participants were age 25 or older. Students were eligible to participate if they were at least 18 years old and reported past-month alcohol use. Most participants were freshmen (*n* = 93, 35%) or sophomores (*n* = 72, 27%) and were not involved in a fraternity or sorority (*n* = 205, 78%).

The sample was 54% Caucasian, 34% African American; 6% Multiethnic; 3% Hispanic/Latino; 2% Asian; <1% Native Hawaiian/Pacific Islander/Native American/Other. Participants completed self-report measures online and received course credit for completing the study. The university's Institutional Review Board approved all procedures.

Measures

Alcohol consumption—On the Daily Drinking Questionnaire (DDQ; Collins, Park, & Marlatt, 1985) participants provided an estimate of the total number of standard drinks they consumed each day during a typical week in the past month. The DDQ is a reliable measure that is strongly correlated with self-monitored drinking reports (Kivlahan et al., 1990).

Alcohol-Related Consequences—The Young Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006) is a 48-item self-report measure assessing alcohol-related consequences over the past 6 months. The YAACQ has demonstrated good test-retest reliability and predictive validity (Read et al., 2007). Internal consistency (Cronbach's α) was .96 for the total score.

Alcohol demand—Demand for alcohol was assessed using the Alcohol Purchase Task (APT; Murphy & MacKillop, 2006). On the APT participants are instructed to imagine that they are at a party with friends from 9:00PM until 1:00AM and that they will not consume any alcohol prior to or after the party. They are told that the available drinks are standard size domestic beers (12 oz.), wine (5 oz.), shots of hard liquor (1.5 oz.), or mixed drinks containing one shot of liquor. They were then asked how many drinks they would consume at the following 17 prices: $0 (free), $0.25, $0.50, $1.00, $1.50, $2.00, $2.50, $3.00, $4.00, $5.00, $6.00, $7.00, $8.00, $9.00, $10.00, $15.00, and $20.00. Reported consumption was plotted as a function of price, and expenditures at each price were computed by multiplying consumption by price for each amount.

Murphy et al. (2009) found that intensity and O_{max} demonstrated excellent test-retest reliability (*rs* = .89 and .90, respectively), and that elasticity demonstrated acceptable test-retest reliability (*r* = .75).

Elasticity was derived using GraphPad Prism v. 5.04 for Windows (GraphPad Software, San Diego, CA, USA, www.graphpad.com) and the macro available online through the Institute for Behavioral Resources website (www.ibrinc.org). Elasticity was generated from Hursh and Silberberg's (2008) exponential equation: $\log Q = 1\log Q_0 + k(e^{-aP} - 1)$. In this equation, Q = quantity consumed, Q_0 = consumption at $0.00, k = range of alcohol consumption in logarithmic units, P = price, and a = elasticity. In the present study, k was held constant across curve fits at 2.60. Larger values of a indicate greater elasticity (i.e., greater sensitivity to price). Consumption values of zero, which cannot be log transformed, were eliminated prior to calculating elasticity, as were participant data in which less than five consumption values were provided and/or where missing data occurred for more than one price on the APT. Given that this sample included a number of relatively light drinkers who made fewer than five purchases on the APT and some were omitted for poor curve fit, a total of 115 participants had valid elasticity values.

Alcohol Craving—The Penn Alcohol Craving Scale (PACS; Flannery, Volpicelli, & Pettinati, 1999) is a five-item, self-report measure that assessed past-week intensity of alcohol craving, frequency of alcohol craving, ability to resist alcohol, and duration of alcohol craving. The PACS uses a Likert scale of 0 to 6 for each item, with higher scores indicating higher levels of craving. The items may be summed to create a total score of past-week craving. The PACS has demonstrated excellent internal consistency and construct validity (Flannery et al., 1999). Cronbach's α in the current sample was .88.

Trauma History—The Trauma History screen (THS; Carlson et al., 2011) measured lifetime exposure to 14 potentially traumatic events and individuals' reaction to these events. Additionally, the THS assesses Criterion A for PTSD as specified in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV-TR; APA, 2000) through the inclusion of two questions that assess fear of actual or threatened physical harm and if the participant responded with intense fear, helplessness, or horror. The THS has demonstrated adequate reliability and convergent validity in a range of samples including college students (Carlson et al., 2011). The THS was used to ensure that all participants in the study who reported PTS symptoms did in fact experience a Criterion A traumatic event.

Posttraumatic Stress Symptoms—Past month posttraumatic stress symptoms (PTS) were screened using the Primary Care-PTSD Screen (PC-PTSD; Prins et al., 2003), a 4 dichotomous item screening questionnaire assessing symptoms related to each DSM-IV-TR symptom cluster of PTSD: re-experiencing, avoidance, numbing, and hyperarousal. We classified individuals as PTS+ if they endorsed at least one traumatic event on the THS and received a score of 3 or 4 on the PC-PTSD. Prins et al. (2003) found the PC-PTSD demonstrated sound psychometric properties with sensitivity of .78 and specificity of .87 using a cutoff score of 3, and this cutoff score was used in the current study. Prins et al. (2003) found that the PC-PTSD accurately identified more patients with PTSD than the Clinician Administered PTSD Scale (Blake et al., 1990), which is known as the gold standard for PTSD assessment. Although this measure was created as a screening measure for primary care in the Veterans Affairs, the PC-PTSD has shown good psychometric properties in civilian populations (van Dam et al., 2010) and is an ideal measure to use in larger samples where diagnostic interviews are not feasible. Cronbach's α in the current sample was .78.

Data Analysis Plan

Outliers were corrected using methods described by Tabachnick and Fidell (2013). Values exceeding 3.29 standard deviations above or below the mean were recoded to be one unit greater or lower than the greatest non-outlier value, respectively. Additionally, distributions were checked for skewness and kurtosis and transformed as appropriate using log and square root transformations. Following transformations, all final variables had acceptable levels of skewness and kurtosis (i.e., between −1 and 1). We transformed the following variables: drinks per week, craving, intensity, O_{max}, elasticity, and YAACQ.

We first ran correlations between PTS status, drinks per week, demand variables, alcohol-related consequences, and craving. We next conducted mediation analyses using the

PROCESS Macro (Hayes, 2013) to examine whether craving and alcohol demand indices mediated the relation between PTS status and alcohol-related consequences using a nonparametric bootstrapping method, which makes no assumptions about the sampling distribution. We used a nonparametric bootstrapping method of 5,000 samples using a confidence interval of 95% to test the indirect association of PTS status on alcohol-related consequences through the path of craving and demand. An indirect association is considered to be significant if the confidence interval does not include 0. We first ran each variable in separate models, and next tested each significant variable in a multiple mediators model. Each of the mediation models included the covariates of age, sex, ethnicity, and typical drinks per week. The dependent variable and mediators were regressed on each of the covariates.

Results

Descriptive Information on PTS Status, Alcohol Consumption, Alcohol Craving, Alcohol Demand, and Alcohol-Related Consequences

Sixty-four participants (24%) screened positive for PTS symptoms (based on a cut-score of 3). The most frequently reported types of trauma were sudden death of family or close friend (n = 173; 66%), transportation accident (n = 75, 28%), and witnessing someone's death or serious injury (n = 68; 26%). The average number of traumas experienced was 2.58 (SD = 2.16). Participants reported an average of 7.84 (SD = 7.37) drinks per week and an average of 9.62 alcohol-related consequences (SD = 10.07) in the past six months. Participants reported an average of 6.07 (SD = 4.10) on alcohol craving (out of a maximum score of 30).

There were no significant sex differences in PTS status or number of traumatic experiences, although women were significantly more likely to report avoidance symptoms χ^2 (1, n = 264) = 4.39, p = .04, phi = .12) than men. Men reported significantly higher levels of weekly drinking (t(74.14) = 2.90, p = .005) than women.

The Hursh and Silberberg (2008) demand curve elasticity equation provided an excellent fit (R^2 = .99) for the aggregated data (i.e., sample mean consumption values), and a good fit to individual participant data (mean R^2 = .82). Although there is no accepted criterion for adequacy of demand-curve fit, and R^2 may not function well as a measure of curve fit with nonlinear models (Johnson & Bickel, 2008), the authors used a similar criterion as Reynolds and Schiffbauer (2004) and only included elasticity values for analyses when the demand equation accounted for at least 30% of the variance in the participant's consumption (7 participants were excluded from the elasticity analyses, but not the other demand curve analyses, for this reason). Additionally, as noted earlier, only 115 participants reported the required number of consumption values in order to compute elasticity, and we therefore did not have elasticity values for a total of 108 participants. There were no significant differences in PTS status or demographic variables, but there were significant differences in alcohol consumption values between participants with and without valid elasticity values. An examination of the data revealed that the poor curve fits were often due to having very few non-zero consumption values on the APT.

Correlations between Variables

Table 1 displays correlations between PTS status, alcohol consumption, alcohol demand, alcohol-related consequences, and alcohol craving. It should be noted that smaller demand elasticity values reflect *less* price sensitivity and *greater* alcohol reward value. PTS status was correlated with alcohol-related consequences and alcohol craving. Weekly alcohol consumption was correlated with all alcohol demand variables, alcohol-related consequences, and alcohol craving. All alcohol demand variables were intercorrelated. Alcohol demand variables were also correlated with alcohol-related consequences and alcohol craving, with the exception of O_{max} having no significant relationship with alcohol craving.

Craving and Demand as Mediators of the Relation between PTS and Alcohol-Related Consequences

We next tested craving and alcohol demand indices separately as mediators of the relation between PTS status and alcohol-related consequences using the PROCESS macro, while controlling for age, sex, ethnicity, and typical drinks per week (Table 2). Although we did not find significant associations between PTS status and alcohol demand, this is not a necessary requirement for investigating indirect effects (Hayes, 2009). As shown in Table 2, PTS and alcohol demand (other than O_{max}) demonstrated significant associations when covariates were included. In the first models that included craving, intensity, O_{max}, and elasticity separately, craving, intensity, and elasticity were significant mediators. O_{max} was not a significant mediator. We next conducted a multiple mediators analysis with all variables that showed significance in the single mediation models. In the multiple mediators model that included craving, intensity, and elasticity and controlled for age, sex, ethnicity, and typical drinks per week, only craving remained a significant mediator of the relationship between PTS status and alcohol-related consequences. The results of the final mediation model are shown in Table 3. Note that 96 individuals were included in the final model due to missing data on any of the variables (primarily elasticity)[1].

Discussion

We examined the implications of a positive screen for PTSD symptoms (PTS+) on a variety of alcohol-related outcomes in a sample of undergraduate alcohol users from an ethnically diverse urban university. Almost a quarter of participants reported experiencing a Criterion A traumatic event and sufficient symptoms to elicit a PTS+ screen, which in turn was associated with alcohol-related consequences through the pathway of craving and alcohol demand. We found significant correlations among many of the variables we investigated, including PTS, craving, and alcohol-related consequences. Although alcohol demand was associated with craving and with alcohol problems, in contrast to the results of Murphy et al. (2013), alcohol demand was not associated with PTS, although we did find significant associations between PTS and demand when adjusting for demographic and alcohol consumption variables. This may be due to the overall lower level of drinking observed in

[1]An exploratory model that included craving and intensity only (n =210) also indicated that craving was the only significant multivariate mediator.

the current sample; PTS may have a stronger direct association with elevated alcohol demand among heavier drinkers.

Most importantly, this study sheds light on two potential mechanisms - craving and alcohol demand - by which PTS symptoms might be associated with alcohol-related consequences. Craving, alcohol intensitym and elasticity were associated with alcohol-related consequences, and significantly mediated the association between PTS and alcohol problems even after controlling for drinking level and demographic variables. This is consistent with previous research indicating that craving and demand are unique risk factors for alcohol-related consequences (Amlung & MacKillop, 2015; Rosenberg & Mazzola, 2007; Skidmore et al., 2014). It is interesting that alcohol demand variables were unrelated to PTS and alcohol problems in bivariate correlations; intensity and elasticity only showed statistically significant associations with PTS status and alcohol-related consequences in the single mediator models that included demographic and alcohol consumption covariates. Individual differences in demand may be most relevant to PTS and alcohol–related consequences within groups of individuals with similar demographic and drinking characteristics.

The multiple mediators model did not demonstrate significant relationships between alcohol demand and PTS status, suggesting that craving accounts for the mediating role of demand on alcohol-related consequences. Another possibility is that PTS symptoms may increase alcohol demand because of the negative reinforcement properties, which then may lead to increased craving for alcohol, and this may lead to more alcohol-related consequences. This pathway may be a possible examination for future studies. PTS symptoms may lead to a pattern of dysregulated drinking that includes craving, excessive drinking in situations where drinks are free (demand intensity), and less sensitivity to increasing drink prices (elasticity), perhaps in order to reduce the impact of stress or intrusive images, even in the absence of overall elevations in weekly drinking. This may in part account for the elevated rates of alcohol-related consequences among individuals with PTS symptoms.

Craving mediated the relation between PTS status and alcohol-related consequences even after adding intensity and elasticity to the model, and also showed a significant direct relation with PTS, indicating that craving may be a more central explanation of the relation between PTS symptoms and alcohol-related consequences. Although several studies have linked craving and problematic alcohol use (Coffey et al., 2010; Simpson et al., 2012), this is the first study to find that craving partially explains the relation between PTS symptoms and alcohol-related consequences. Craving may be an especially important target in alcohol treatment for young adults with PTS symptoms, as it may predict worse outcomes related to problematic drinking even after taking into account level of demand. Previous studies have found that laboratory induced craving led to increased demand for alcohol (Amlung et al., 2015; MacKillop et al., 2010), and that elevated demand predicts poor brief alcohol intervention response (Dennhardt et al., 2014). Future research should investigate elevated craving and demand as predictors of treatment response among drinkers with PTS symptoms.

Limitations

Although our measures of substance use, demand, and PTS status are widely used and have shown strong psychometric properties (Murphy et al., 2009; van Dam et al., 2010), the self-report, retrospective measurement approach did not allow us to capture real-time variability in PTS symptoms, demand, craving, and alcohol use/consequences. Moreover, we used a brief measure of PTS symptoms that did not allow us to establish a PTSD diagnosis or permit continuous analyses of severity or PTS symptom clusters (Avant et al., 2011). In this sample, levels of craving were low and it will be important to replicate these findings with heavier drinkers. It is also possible that trait negative affect may contribute to the relationships we found between PTS and alcohol-related outcomes, but we did not measure this in our study.

Because our study was cross sectional, and several of our measures assessed different timeframes, we cannot definitively conclude that PTS symptoms cause alcohol-related consequences via their influence on craving and alcohol demand. PTS symptoms (past month) and craving (past week) were assessed in a shorter timeframe than alcohol-related consequences (past 6 months). Mediation models hypothesize that the independent variable precedes the mediator, which precedes the dependent variable. There is research that states that alcohol use may increase risk for future traumatic events or PTS (Back et al., 2006). It is possible that in this study, some individuals may have engaged in risky drinking prior to trauma exposure and even experienced trauma because of risky drinking. In this case elevated desire for alcohol, as manifest by high levels of craving and alcohol demand, may increase risk for both trauma and alcohol consequences. The results of our study, along with previous prospective and laboratory research linking both craving and alcohol demand to alcohol misuse, provide support for future longitudinal research investigating the unique role of craving, demand intensity, and demand elasticity in accounting for alcohol problems among individuals who experience trauma. Finally, although the use of a college sample with relatively low levels of drinking, craving, and alcohol demand may not allow for generalization to other heavier drinking populations, this urban, ethnically diverse sample of largely first-generation college students may generalize well to population samples of young adults with a range of drinking patterns.

Clinical Implications

A primary clinical implication is that college students with PTS+ screens may have higher levels of craving for alcohol and may in turn experience alcohol-related consequences, such as blackout drinking, missing school or work, and negative social interactions due to alcohol use. Therefore, college-counseling centers should be careful to screen for risky drinking and the presence of craving, especially in individuals who present with trauma and PTS symptoms. This study highlights the importance of craving as a factor that may lead to alcohol-related consequences in college students with PTS symptoms. Although alcohol intensity and elasticity did not remain mediators of the relationship between PTS status and alcohol-related consequences in the multivariate mediation model, our findings indicate that elevated demand among college students with PTS is an important predictor of alcohol-related consequences above and beyond typical consumption and other demographic variables.

Conclusion

This is the first study to examine PTS, craving, alcohol demand, and alcohol-related consequences simultaneously in a large and diverse young adult sample with a range of drinking and PTS symptoms levels. The current study suggests that college students with a PTS+ screen may be more likely to experience alcohol-related consequences, and this may be partially explained by higher levels of craving and alcohol demand. Future longitudinal research should clarify this relationship using more precise measurement approaches and other high-risk samples.

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Table 1

Correlations between PTS Status, Alcohol Consumption, Craving, Alcohol Demand, and Alcohol-Related Problems

	PTS Status	Drinks per week	PACS	Intensity	O_{max}	Elasticity	YAACQ
1. PTS Status	--	−.01	.18**	.11	−.01	−.03	.20**
2. Drinks per week†	--	--	.42***	.49**	.16**	.31***	.45***
3. PACS†	--	--	--	.32**	.06	.34**	.39**
4. Intensity†	--	--	--	--	.34**	−.31**	.35**
5. O_{max}†	--	--	--	--	--	−.40**	.12*
6. Elasticity†	--	--	--	--	--	--	−.25**

Note. PTS Status = PTSD Screening Status; PACS = Penn Alcohol Craving Scale; YAACQ = Young Adult Alcohol Consequences Questionnaire; O_{max} = maximum alcohol expenditure

** $p < .01$

* $p < .05$

† variable was transformed

Table 2

Summary of Final Mediation Analysis (5,000 bootstrap samples; n = 103–203). Each Mediator Run Separately.

Independent Variable (IV)	Mediating variable (M)	Dependent variable (DV)	IV to M Coefficient	M to DV Coefficient	Indirect Effect Coefficient	SE	95% CI
PTS Status	Craving†	YAACQ†	.43*	.10*	.04	.02	[.01, .10]*
PTS Status	Intensity†	YAACQ†	.09*	.26*	.02	.02	[.001, .07]*
PTS Status	O_{max}†	YAACQ†	.01	−.01	−.0001	.01	[−.01, .01]
PTS Status	Elasticity†	YAACQ†	−.02*	−2.99*	.05	.03	[.006, .12]*

Note. PTS Status = PTSD Screening Status; PACS = Penn Alcohol Craving Scale; YAACQ = Young Adult Alcohol Consequences Questionnaire

*Statistical significance determined by confidence intervals excluding zero

†variable was transformed

Table 3

Summary of Final Mediation Analysis (5,000 bootstrap samples; n = 96).

Independent Variable (IV)	Mediating variable (M)	Dependent variable (DV)	IV to M Coefficient	M to DV Coefficient	Indirect Effect Coefficient	SE	95% CI
PTS Status	---	YAACQ†			−.002	.09	[−.19, .18]
PTS Status	Craving†	YAACQ†	.78*	.11*	.08	.04	[.03, .19]*
PTS Status	Intensity†	YAACQ†	.11	.35*	.02	.05	[−.002, .06]
PTS Status	Elasticity†	YAACQ†	−.01	−1.68	.01	.02	[−.01, .08]

Note. PTS Status = PTSD Screening Status; PACS = Penn Alcohol Craving Scale; YAACQ = Young Adult Alcohol Consequences Questionnaire

*Statistical significance determined by confidence intervals excluding zero

†variable was transformed