

# Stress Mediates the Association Between Pain and Alcohol Use in College Students

Nicholas J Bush<sup>1</sup> , Melissa R Schick<sup>1</sup>, Nichea S Spillane<sup>1</sup>, Jeff Boissoneault<sup>2</sup>

<sup>1</sup>Department of Psychology, University of Rhode Island, Kingston, RI, USA; <sup>2</sup>Department of Clinical and Health Psychology, University of Florida, Gainesville, FL, USA

Correspondence: Nichea S Spillane, Department of Psychology, University of Rhode Island, 130 Flagg Road, Kingston, RI, 02881, USA, Tel +1 401-874-4252, Email nspillane@uri.edu

**Background:** Alcohol use in young adults is highly prevalent and associated with numerous consequences, including academic difficulties and motor vehicle accidents. Pain is one factor that has been increasingly shown to be associated with higher rates of alcohol consumption and riskier patterns of drinking among undergraduate students. Although pain has traditionally been viewed as a lesser concern for young adults, current research demonstrates that pain may be more prevalent in younger populations than originally thought. However, little is known about how common psychosocial factors, such as stress and subjective social status (SSS), influence the association between pain and alcohol consumption in college students.

**Objective:** The study's goal was to examine the effect of stress and SSS on the relationship between pain and alcohol consumption.

**Participants and Methods:** Participants ( $N = 445$ , 39.3% women,  $M_{age} = 22.98$ ) were 18- to 25-year-old college students who completed an online questionnaire.

**Results:** Pain was significantly associated with total weekly alcohol consumption ( $r(445) = .22$ ,  $p < 0.001$ ); this association was significantly mediated by stress ( $b = 0.15$ ,  $SE = 0.04$ , 95% CI = [.07, 0.23]). SSS was significantly positively associated with alcohol consumption ( $r(445) = .22$ ,  $p < 0.001$ ) but was not found to significantly moderate the relationship between stress and alcohol use.

**Conclusion:** Results suggest that efforts to reduce college student alcohol use should include assessment of pain and stress given their association with alcohol consumption. Further, findings suggest that future studies are warranted to prospectively examine pain as an antecedent for alcohol use and to examine the utility of incorporating stress management techniques in pain-focused interventions to indirectly target alcohol use.

**Keywords:** alcohol, stress, pain, college students

## Introduction

More than half of full-time college students in the United States report past-month alcohol consumption.<sup>1</sup> Young adulthood is the time in life which represents the peak age of onset for alcohol use disorder.<sup>2</sup> Perhaps even more concerning is that the high prevalence of alcohol use in this population is associated with numerous consequences, such as impaired driving, alcohol-related unintentional injuries and deaths, and trouble with residence hall or other college authorities.<sup>3-6</sup> Moreover, research suggests that high-frequency drinking patterns that develop during college may persist for several years post-graduation.<sup>7</sup>

Pain has been found to be associated with alcohol use. In the United States, an estimated 50 million individuals experience chronic pain, defined as pain lasting for more than 3 months.<sup>8</sup> While chronic pain is prototypically associated with older adults,<sup>9</sup> research suggests college students may be at elevated risk for experiencing events that may lead to pain, such as athletic injuries.<sup>10</sup> For instance, one study of 18- to 25-year-olds from general healthcare practices found that 66.9% of the sample endorsed experiencing pain within the previous six months. Further, 14.3% of respondents met criteria for chronic pain, with 3.0% reporting severely disabling chronic pain.<sup>11</sup> In addition, a meta-analysis of population-level studies suggests that estimates of chronic pain in this age group, while lower than the general adult population (43.5%; 12), may be as high as 14.3%.<sup>12</sup> While this estimate is lower than for other age groups, research suggests that the time course and length of duration of pain are important indicators of chronicity and functional

outcomes.<sup>59,60</sup> This is concerning, as inadequate pain treatment may impair physical functioning and sleep and is associated with high economic costs and deleterious health outcomes.<sup>13</sup> For undergraduate students, pain may also result in significant interference with their education and ability to complete their schoolwork.<sup>14</sup> Poorly controlled pain may lead some to find alternative ways to deal with the experience of pain. As such, a significant association has been demonstrated between pain and alcohol use.<sup>15,16</sup> Research has found that pain is strongly and positively associated with substance use<sup>17</sup> among college students, and students with chronic pain are much more likely to use alcohol and other analgesics.<sup>14</sup> Further, pain has been shown to be an important predictor of heavy drinking episodes during alcohol use treatment,<sup>18</sup> and decreased pain severity has been associated with decreased likelihood of alcohol use relapse following treatment.<sup>19</sup> Given the positive association between pain and alcohol use in this population, it is important to understand psychosocial factors that may be underlying this relationship.

One such factor that may be helpful in understanding the association between pain and alcohol consumption is perceived stress. Undergraduate students report experiencing high levels of stress, with approximately 75 to 80% of college students reporting moderate stress and 10 to 12% reporting severe stress.<sup>20,21</sup> Previous work has found a strong significant positive association between perceived stress and intensity of pain.<sup>22</sup> Stress also has been shown to be positively associated with alcohol use among college students. In laboratory studies, acute stress has been found to increase single-session alcohol intake.<sup>23</sup> Similarly, cross-sectional research has shown that students are more likely to drink and drink more heavily on days that they endorse a greater number of life stressors.<sup>24</sup> Despite robust evidence demonstrating the associations between pain and stress and alcohol and stress individually, little work has been done examining the potential relationship between pain and stress in college student samples.

Another important psychosocial factor may be socioeconomic status (SES), which has been shown to have a significant association with both alcohol use and perceived stress.<sup>25</sup> Traditionally, SES has been measured using objective metrics, including income and educational level. Lower objective SES has also been shown to be associated with chronic stress and higher levels of stress-related hormones, such as cortisol.<sup>26,27</sup> However, a limitation of this existing literature is that, in college populations, objective SES measures may be more sensitive to parents' socioeconomic status rather than how the student perceives their own status within their college environment.<sup>28</sup> An alternative measure is subjective social status (SSS), in which individuals rank themselves on a ladder in relation to where they perceive their position in their communities to be. Subjective metrics like SSS have been shown to capture youth perceptions of SES more comprehensively than objective measures.<sup>29,30</sup> SSS has also been shown to be a robust and better predictor of health status and health decline than objective measures of SES.<sup>31,32</sup> In adolescents, SSS was demonstrated to have a strong negative association with perceived stress.<sup>33</sup> In addition, SSS is not only associated with stress but also with factors related to increased risk of using substances to self-manage pain, such as greater negative effect and utilization of fewer active coping strategies.<sup>34,35</sup> While the literature on SSS in the college student population is limited, previous research suggests that higher levels of SSS are associated with higher levels of alcohol consumption and a greater likelihood of regular alcohol use.<sup>36,37</sup>

The goal of the current study was to assess the relationship between pain and alcohol consumption and to examine stress and SSS as potential moderators of this association in an online sample of 18 to 25-year-old college students. Understanding how these factors interact with each other will aid in the development of new approaches to target undergraduates' alcohol consumption. We hypothesized there would be a relationship between average pain experienced and total weekly alcohol consumption, and that stress would mediate this association. Given SSS's association with stress, self-medication for pain risk factors and alcohol use, we also expected that SSS would moderate the association between stress and alcohol consumption, such that students reporting higher stress and SSS would also report greater alcohol consumption.

## Methods

### Participants and Procedure

Respondents were recruited from Amazon's Mechanical Turk (MTurk) platform, which has been shown to generate relatively reliable data<sup>38,39</sup> and represent the general population in terms of demographics.<sup>40</sup> Participants between the ages of 18 and 25 were screened for the larger study based upon three inclusionary criteria: (1) living in the United States; (2) able to read and answer questions in the English language; and (3) currently enrolled as an undergraduate

student at a college or university. Participants who met eligibility criteria provided informed consent and completed the survey on Qualtrics. Participants were compensated \$0.50 for study participation. All procedures were approved by the Institutional Review Board at the University of Rhode Island and complied with the Declaration of Helsinki of 1964 ethical guidelines prior to beginning data collection procedures.

## Exclusions and Missing Data

Of the 2085 obtained responses to the screening, 135 potential participants did not complete the survey (remaining  $n=1950$ ). Additionally, 1212 prospective participants were excluded for being over the age of 25, and 111 were excluded for not being currently enrolled in college (remaining  $n = 627$ ). We then excluded one potential participant (remaining  $n = 626$ ) who failed to pass at least one of the four validity checks placed throughout the survey to ensure attentive responding (two items; eg, participants being asked to rate “I have never brushed my teeth” on a three response option scale from “yes” to “no” to “strongly agree”) and comprehension (two items, asking participants to “please click yes” with response options “yes,” “no,” and “not sure”; 42–44). For the purpose of the present study, an additional 101 participants were excluded because they did not report any pain in the last month on the Medical Outcomes Survey – Short Form (MOS-SF 36, see Measures) (remaining  $n = 525$ ) and 80 (remaining  $n = 445$ ) were excluded for not responding to either question regarding typical alcohol consumption or frequency of drinking alcohol. Thus, the final sample used for the present study included 445 participants. See Table 1 for participant demographic characteristics.

## Measures

### Demographics

Participants were asked to report their age, gender, race, ethnicity, and student status (see Table 1).

### Medical Outcomes Survey – Short Form 36-Item (MOS-SF 36)

The MOS-SF 36 is a 36-item self-report measure that measures the generic health status across eight health-related areas.<sup>41</sup> Pain was assessed as a screening measure using the item “how much bodily pain have you had during the past 4 weeks?” on a 6-point scale from “none” to “very severe.” Participants who selected the option “none” were screened out (see Exclusions and Missing Data).

### Brief Pain Inventory – Short Form (BPI-SF)<sup>42</sup>

The BPI-SF is a 9-item self-report measure that assesses the location of pain in the body, severity of pain, and its impact on functioning.<sup>42</sup> Pain on average was measured with one item, using a visual analog scale assessing severity of pain anchored on the left as “no pain” and on the right as “pain as bad as you can imagine.” The use of single-item VAS is consistent with recommendations by the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT).<sup>45</sup>

### Student-Life Stress Inventory (SLSI)<sup>43</sup>

The SLSI is a 51-item self-report measure that assesses stressors and reactions to stressors across 9 subscales: frustration, conflict, pressure, change, self-imposed, physiological, emotional, behavioral, and cognitive.<sup>43</sup> Higher scores in each subscale, except for cognitive, indicate higher stress levels. In the cognitive subscale, lower scores indicate greater stress. Each item was rated on a Likert-type scale assessing how often the participant has experienced each item ranging from 1 = never to 5 = always. Items in the cognitive appraisal subscale were first reversed scored, then all items were added together to produce a total perceived stress score. The SLSI has good psychometric properties,<sup>43,44</sup> including in the present study ( $\alpha = 0.97$ ).

### MacArthur Subjective Social Status Scale<sup>34</sup>

The Subjective Social Status Scale is a single-item self-report measure that assesses subjective social status by asking participants to rank themselves on one of ten rungs of a visual ladder.<sup>34</sup> Participants were provided a picture of a ladder on which they should select the point that best represented their standing within their community.

People define community in different ways; please define it in whatever way is most meaningful to you. At the top of the ladder are the people who have the highest standing in their community. At the bottom are the people who have the lowest standing in their community. Where would you place yourself on this ladder?

**Table 1** Participant Demographics (N=445)

| Characteristic                            | Mean (SD) or % |
|-------------------------------------------|----------------|
| Age (years)                               | 23 (1.9)       |
| Gender                                    |                |
| Man                                       | 269 (60.4)     |
| Woman                                     | 175 (39.3)     |
| Transgender                               | 1 (0.3)        |
| Ethnicity                                 |                |
| Hispanic                                  | 148 (33.3)     |
| Not Hispanic                              | 296 (66.5)     |
| Race                                      |                |
| White                                     | 339 (76.2)     |
| Black or African American                 | 53 (11.9)      |
| Asian                                     | 40 (9.0)       |
| American Indian/Alaska Native             | 20 (4.5)       |
| Native Hawaiian or other Pacific Islander | 10 (2.2)       |
| Year of College                           |                |
| Freshman                                  | 25 (5.6)       |
| Sophomore                                 | 76 (17.1)      |
| Junior                                    | 113 (25.4)     |
| Senior                                    | 231 (51.9)     |
| Average Pain (0–100 VAS)                  | 40.3 (26.7)    |
| Pain Severity (MOS-SF)                    |                |
| Very Mild                                 | 141 (31.7)     |
| Mild                                      | 109 (24.5)     |
| Moderate                                  | 129 (29.0)     |
| Severe                                    | 53 (11.9)      |
| Very Severe                               | 13 (2.9)       |
| Pain Interference (MOS-SF)                |                |
| Not at all                                | 39 (8.8)       |
| A little bit                              | 133 (29.9)     |
| Moderately                                | 172 (38.7)     |
| Quite a bit                               | 64 (14.4)      |
| Extremely                                 | 27 (6.1)       |
| Total Pain Score (MOS-SF)                 | 90.5 (42.2)    |
| Weekly Alcohol Consumption (Drinks)       | 23.1 (34.7)    |
| Perceived Stress (51–255)                 | 164.3 (34.7)   |
| Subjective Social Status (0–10 Ladder)    | 6.72 (1.98)    |

Assessment of SSS using the MacArthur scale has demonstrated moderate test-retest reliability<sup>45</sup> and strong construct validity.<sup>46</sup> In addition, Single-item SSS ladders have been shown to demonstrate moderate test-retest reliability and strong construct validity<sup>29,61</sup> and good intraclass correlations (0.73–0.79) among American adolescents.<sup>62</sup>

### NIAAA Six Question Set

The NIAAA Recommended Six Question Set<sup>47</sup> is a 6-item self-report measure that assesses past-year frequency of alcohol use, quantity of drinks consumed, and frequency of binge drinking. Drinking frequency was measured by asking how often respondents consumed alcohol in the past year. Alcohol consumption quantity was measured by asking respondents to select how many drinks they consumed on a typical drinking day in the past year. A total alcohol consumption score was created by computing the product of quantity and frequency of alcohol consumption, which

represented total number of drinks consumed per week, consistent with similar quantity-frequency alcohol measures used in extant research.<sup>48</sup>

## Data Analysis

Analyses were conducted using IBM SPSS Statistics Version 25. First, Pearson product-moment correlations were calculated among relevant study variables to explore their bivariate associations. Next, mediation and moderation hypotheses were tested using the PROCESS macro developed by Hayes and Preacher.<sup>49</sup> The PROCESS procedures use ordinary least squares regression and bootstrapping methodology, which confers more statistical power than do standard approaches to statistical inference. All variables were assessed for normality using skewness and kurtosis statistics. We determined an index violated normality if either skewness or kurtosis was greater than or equal to the absolute value of 2.<sup>63</sup> Only the weekly alcohol consumption variable was considered non-normal (skewness = 2.32, kurtosis = 6.22). Due to the positive skewness, we used a square-root transformation on the raw values (skewness = 0.97, kurtosis = 0.58). First, we examined the mediating role of stress in the association between pain and alcohol consumption (PROCESS Model 4). Bootstrapping was done with 10,000 random samples generated from the observed covariance matrix to estimate the standard errors of parameter estimates and the bias-corrected 95% confidence intervals of the indirect effects. The indirect effect is significant if the 95% confidence interval does not contain zero.<sup>50</sup> Then, we examined a second-stage moderated mediation model to examine SSS as a moderator of the association between stress and alcohol consumption. For moderation analyses, continuous predictor variables were mean-centered prior to the construction of the interaction term to aid in the interpretation of parameter estimates and to lessen the correlation between the interaction term and its component variables.

## Results

Exploratory analyses were conducted assessing sex as a moderator along the pain to alcohol use pathway. Results indicated that sex was not a significant moderator ( $p > 0.05$ ). In addition, all models were also run using the MOS-SF pain subscale. This resulted in the same pattern of results and significance as the single item VAS from the BPI-SF.

## Bivariate Correlations

Average pain was significantly positively associated with weekly alcohol consumption ( $r(445) = 0.26, p < 0.001$ ) and perceived stress ( $r(445) = 0.56, p < 0.001$ ). Additionally, perceived stress was significantly positively correlated with alcohol consumption ( $r(445) = 0.32, p < 0.001$ ) and SSS ( $r(445) = 0.24, p < 0.001$ ). SSS was also significantly positively correlated with alcohol consumption ( $r(445) = 0.21, p < 0.001$ ). See Table 2 for bivariate correlations among all variables of interest.

## Mediation Analysis

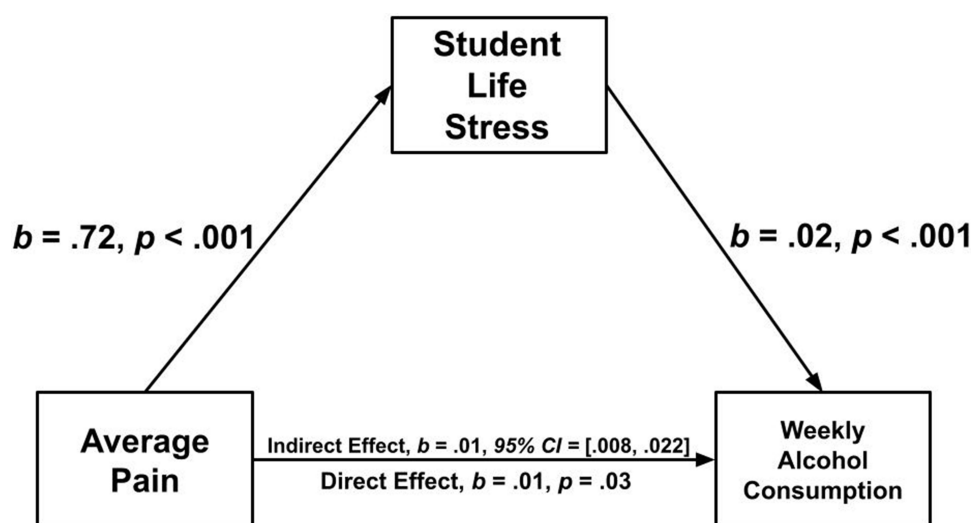
The overall model examining the role of perceived stress underlying the association between pain and alcohol consumption, controlling for the effects of age and gender, was significant (see Figure 1,  $F(4, 440) = 16.45, R^2 = 0.13, p < 0.001$ ). The relationship between pain and perceived stress was significant ( $b = 0.72, SE = 0.05, t = 13.95, p < 0.001$ ), as was the association between stress and alcohol consumption ( $b = 0.02, SE = 0.004, t = 4.75, p < 0.001$ ). Further, the indirect effect of

**Table 2** Correlations Among Relevant Constructs

|                               | 1 | 2     | 3     | 4     |
|-------------------------------|---|-------|-------|-------|
| 1. Average Pain               | – | 0.22* | 0.56* | 0.35* |
| 2. Weekly alcohol consumption |   | –     | 0.28* | 0.22* |
| 3. Perceived stress           |   |       | –     | 0.24* |
| 4. SSS                        |   |       |       | –     |

**Note:** \* $p < 0.001$ .

**Abbreviation:** SSS, subjective social status.

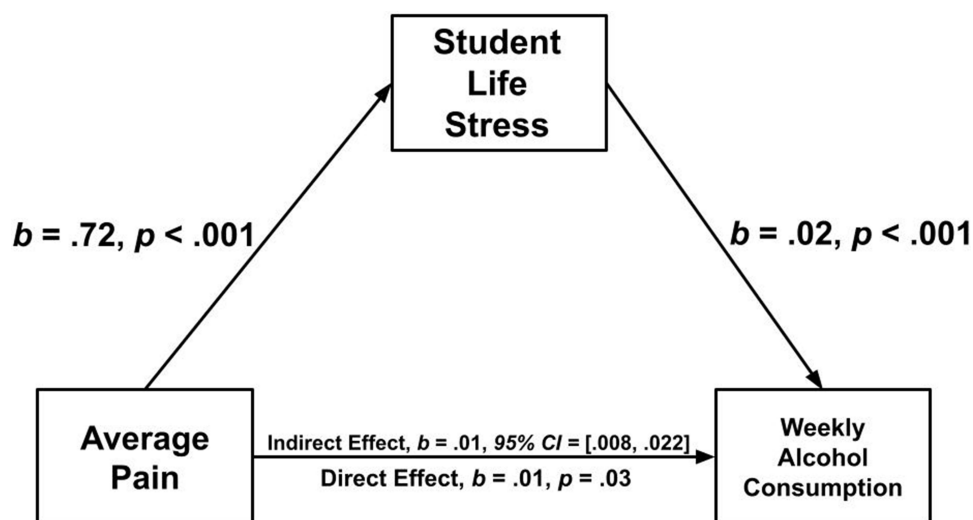


**Figure 1** Summary of analyses explicating the role of stress in the relation between pain and weekly alcohol consumption.

pain on alcohol consumption through the pathway of perceived stress was also significant ( $b = 0.01$ ,  $SE = 0.004$ , 95% CI [0.008, 0.022]), while the direct effect linking average pain with weekly alcohol consumption remained significant after controlling for the effect of perceived stress ( $b = 0.01$ ,  $SE = 0.006$ ,  $t = 2.20$ ,  $p = 0.03$ ).

### Moderated Mediation Analysis

The overall model examining the moderating effect of SSS on the pathway from stress to alcohol consumption, controlling for the effects of age and gender, was significant (see Figure 2,  $F(6, 438) = 12.51$ ,  $R^2 = 0.15$ ,  $p < 0.001$ ). There were significant main effects of stress ( $b = 0.02$ ,  $SE = 0.004$ ,  $t = 4.45$ ,  $p < 0.001$ ) and SSS ( $b = 0.16$ ,  $SE = 0.07$ ,  $t = 2.41$ ,  $p = 0.016$ ) on weekly alcohol consumption. However, the interaction of stress and SSS on alcohol consumption ( $b = 0.003$ ,  $SE = 0.002$ ,  $t = 1.56$ ,  $p = 0.12$ ) and the index of moderated mediation ( $b = 0.002$ ,  $SE = 0.002$ , 95% CI [-0.0006, 0.0051]) were not significant.



**Figure 2** Summary of the analyses explicating the role of stress and subjective social status in the relation between pain and weekly alcohol consumption.

## Discussion

The goal of this study was to further our understanding of how pain, stress, and SSS are associated with alcohol consumption. Overall, the majority of the present sample reported moderate pain intensity and perceived stress, as well as high levels of alcohol consumption. Each of the factors were significantly interrelated, and stress significantly mediated the relationship between pain and alcohol consumption. Interestingly, subjective social status did not significantly moderate the association between stress and alcohol consumption but did demonstrate a significant main effect on alcohol consumption.

Consistent with earlier research,<sup>14</sup> we identified a significant positive association between pain and alcohol use. This is consistent with research among adults in the United States, which has found greater pain to be associated with greater alcohol use.<sup>16</sup> The present study expands this finding to a younger population and suggests the importance of assessing pain as a motivator for alcohol use when planning interventions. Specifically, students who use alcohol to help manage their pain may benefit from pain management interventions in an effort to reduce their alcohol consumption. Additionally, pain has been found to be related to alcohol consumption at the bivariate level and this association was remained significant after accounting for perceived stress. Pain has been shown to be positively associated with stress and is a stressor in its own right, which may explain their strong association.<sup>51–53</sup> This is an important consideration as research has shown that higher levels of stress are associated with drinking to cope among college students<sup>54</sup> and that 39% of college students reported drinking to cope with stress.<sup>20</sup> This finding suggests that students in groups at high risk for pain, such as collegiate athletes and students with pre-existing conditions, may also be at increased risk for stress and therefore drink more alcohol. Efforts to reduce substance use in these students should consider targeting stress and pain as treatment targets using interventions such Cognitive Behavioral Therapy for Pain (CBT-P) and mindful awareness and acceptance-based treatments.<sup>55,56</sup>

Our finding that SSS was positively correlated at the bivariate level with alcohol consumption is consistent with previous research amongst adolescents.<sup>57,58</sup> Interestingly, perceived stress was also significantly positively associated with SSS. However, in contrast to study hypotheses, SSS did not significantly moderate the pathway between stress and alcohol consumption. One potential explanation for the non-significance of the interaction may be that since stress is highly prevalent amongst college students, the expectation that alcohol will have a stress response dampening effect may exist across SSS groups. Secondly, the majority of our sample reported a SSS higher than 6, which may have limited our ability to characterize effects for those with lower SSS. Future research in this area should include a wider distribution of SSS and consider additional factors such as coping and negative affect when assessing for SSS and alcohol use.

While the findings of this study contribute important knowledge regarding the associations among pain, stress, and subjective social status on alcohol consumption in undergraduate students, they should be considered within the study's limitations. First, the results are cross-sectional and correlational in nature, which limits the ability to determine the directionality of the associations. To address this, future research should examine these relationships through direct experimental manipulations and in a prospective longitudinal framework. In addition, research utilizing ecological momentary assessment may be a useful approach for understanding interindividual dynamics between these variables and provide a prospective framework. Second, our inclusion of the terms “pain” and “alcohol” in the MTurk project title may have resulted in oversampling of students with higher levels of pain or alcohol use; thus, findings may not reflect undergraduate students as a whole. Further, the use of an online sampling platform may introduce limitations resulting from the loss of control over the research environment (eg, because there is no opportunity to clarify questions or limit distractions). In addition, our sample demographics are primarily non-Hispanic White male students which may not generalize the student body as a whole. Thus, future research that integrates other data collection methods (eg, interviewing) and diverse groups of students is warranted. Lastly, future research in this area should consider other potentially relevant moderators, such as sex and race, which may provide additional insight on the role of stress and subjective social status in the association between pain and alcohol consumption.

Taken together, our results extend knowledge of psychosocial factors on the relationship between pain and alcohol consumption among undergraduate students. These findings suggest that psychosocial factors, including pain, stress, and SSS, should be considered when assessing students presenting for prevention or treatment programs targeting

alcohol consumption or when college students present to campus health centers seeking attention for pain. In particular, alcohol use should be assessed among students who are at-risk for developing pain, and pain should be assessed among students referred to treatment due to alcohol use. Additionally, findings of this study suggest that stress reduction and pain management are important foci for targeted interventions to reduce alcohol consumption in college student populations.

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## Disclosure

The authors report no conflicts of interest in this work.

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