

A Pilot Mindfulness Intervention to Reduce Heavy Episodic Drinking

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Approximately one third of college students report heavy episodic drinking (HED; Substance Abuse and Mental Health Services Administration, 2019), defined as four or more drinks for women and five or more drinks for men on a single occasion. This mixed-methods study examined the feasibility of a mindfulness intervention intended to reduce HED. Thirty-six students were assigned to either (a) a 4-week mindfulness intervention or (b) a personalized email. The mindfulness group reported fewer weekend night drinks postintervention. Adaptations that can reduce barriers to attendance will be needed.

Keywords: mindfulness, college students, heavy episodic drinking, feasibility, perceived stress

Approximately one third of college students report engaging in heavy episodic drinking (HED; Substance Abuse and Mental Health Services Administration, 2019), defined as four or more drinks for women and five or more drinks for men on a single occasion. The consequences of HED in college students are wide-ranging and include increased risk for injury, academic problems, and alcohol use disorders (White & Hingson, 2013). Recent data from the American College Health Association (2018) show that about 50% of the students who drank alcohol in the past 12 months reported experiencing one or more negative outcomes, such as feelings of regret or lapses in memory. Aspects of the campus environment that increase risk for HED include institution size and location, school demographics, presence of Greek life organizations, and presence of prominent athletic programs (Clapp & Shillington, 2001; Presley et al., 2002; Scholly et al., 2014). A number of individual-level variables also increase risk for HED in young adults, such as perceived social norms, religiosity, and emotional state (Borsari et al., 2007).

Two individual characteristics that are particularly predictive of alcohol use and alcohol-related problems in young adults are negative affect (Borsari et al., 2007; Neighbors et al., 2007) and impulsivity (Cyders et al., 2009; Magid & Colder, 2007). Although impulsivity has been shown to decrease with increasing age and broader developmental and maturational changes (Lee & Sher, 2018; Steinberg et al., 2008), evidence suggests that those with a slower decline in impulsivity may be at higher risk for substance use problems (Quinn & Harden, 2013). Furthermore, evidence suggests that problematic drinking itself may predict increases in impulsivity (Riley et al., 2018). In particular, it appears that the tendency to act impulsively while experiencing negative affect

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leads to increased alcohol use in young adults (Murphy & MacKillop, 2012). This aligns with Marlatt and Witkiewitz's (2005) relapse prevention model, which proposes that a lack of necessary coping skills for dealing with high-risk situations, such as negative affect, leads to the tendency to use alcohol to cope and suggests that college students could benefit from learning adaptive coping skills to handle negative emotions more successfully.

The most successful alcohol interventions for college students typically involve motivational interviewing and personalized feedback (Carey et al., 2007). These programs are generally modeled after the Brief Alcohol Screening and Intervention for College Students (BASICS) program (Dimeff, 1999) and provided through college counseling centers. BASICS is an evidence-based intervention that consists of an assessment of the student's current drinking patterns, personalized feedback on alcohol use and consequences, education about the effects of alcohol on the body, advice on reducing risk of alcohol-related problems in the future, and the brainstorming of alternative activities to drinking. Face-to-face interventions grounded in these strategies generally yield the largest effect sizes (Carey et al., 2007), but even a single email providing this personalized information can significantly reduce the number of drinks consumed per week (Bryant et al., 2013). Although existing interventions yield effect sizes for change in alcohol consumption and alcohol-related problems that range from small to medium (Carey et al., 2007), these reductions generally dissipate over time, with few persisting after 6 months (Carey et al., 2007). Thus, interventions are needed that can lead to more lasting change. Because negative affect is associated with greater alcohol consumption (Borsari et al., 2007; Neighbors et al., 2007), the development of new skills to cope with difficult emotions could be beneficial and enhance sustainability of reductions in alcohol use.

A recent meta-analysis (Li et al., 2017) found that mindfulness-based strategies are promising treatment components of substance misuse interventions, with effect sizes on substance use at posttreatment relative to a comparison treatment ranging from $-.07$ to $-.51$ (pooled Cohen's $d = -.28$). According to Kabat-Zinn (2003), the goal of mindfulness training is to teach people how to maintain their attention on their immediate experience while maintaining an attitude of acceptance toward that experience. Theoretically, mindfulness allows people to become more comfortable with their affective states without reacting to them by engaging in substance misuse, such as HED. Because mindfulness encourages acceptance of experiences rather than rashly reacting to them (Ashe et al., 2015), it is theorized to reduce impulsivity, a key risk factor for HED (Murphy & MacKillop, 2012). Several mindfulness interventions have been implemented to address a variety of concerns among college students, including depression and anxiety disorders, stress, and tobacco and alcohol use (Bamber & Morpeth, 2019; de Souza et al., 2015; Falsafi, 2016; Mermelstein & Garske, 2015).

A smaller body of research has applied mindfulness training to college settings to reduce HED, with promising results. A brief, 4-week mindfulness intervention consisting of two in-person meetings and the provision of a CD with mindfulness recordings significantly reduced the frequency of binge-drinking episodes

(defined as four or more drinks for women and five or more drinks for men in a 2-hour period), such that the assessment-only control group reported 2.24 times more binge-drinking episodes than the mindfulness intervention group after 4 weeks (Mermelstein & Garske, 2015). Cross-sectional research in college students also highlights a negative relationship between trait mindfulness and alcohol problems (Bodenlos et al., 2013), which appears to be mediated by the motive to use alcohol as an emotion regulation tool (Roos et al., 2015). Hypothetically, college students who are more mindful are better able to regulate their emotions and therefore might be less likely to rely on alcohol for this purpose.

At present, intervention studies targeting college students have yet to examine mindfulness's influence on intrapersonal factors (e.g., stress, impulsivity) implicated by cross-sectional research on risk for HED. The present pilot study examined how a mindfulness intervention might influence HED in college students, along with established correlates of HED, including impulsivity and perceived stress. Our primary aim was to examine whether the intervention was feasible and acceptable for college students who engage in HED using a mixed-methods approach. Our secondary aim was to conduct exploratory analyses to examine potentially positive trends in the data that could inform a larger, adequately powered clinical trial. We hypothesized that a mindfulness intervention would reduce alcohol use in students who report HED compared with students who received emailed personalized feedback. We also hypothesized that a mindfulness intervention would reduce impulsivity and perceived stress in students who received the intervention compared with students who received emailed personalized feedback.

Method

Participants

Participants were recruited from a midsize, private university located in a major city in the Mid-Atlantic region of the United States through the placement of flyers across campus. Interested students were instructed to call the first author's research lab to complete a brief phone screen to assess eligibility. Participants were eligible if they were a current student at the university, were between the ages of 18 and 25, and reported HED within the past 2 weeks (defined as four or more drinks for women and five or more drinks for men on a single occasion). Participants were ineligible if they reported symptoms of alcohol dependence, as indicated by a score of greater than 20 on the Alcohol Use Disorders Identification Test (Saunders et al., 1993). Eligible participants were instructed to come to the first author's research lab to complete baseline assessment measures and to be randomized to one of two study arms. Data were collected from January to March during the spring semester of 2018. Students in each study arm received an information packet describing the intervention they were assigned to and what they could expect over the following 4 weeks. Thirty-six students enrolled in the pilot study. Three students did not complete any study activities following randomization (i.e., failure to complete any weekly questionnaires, failure to attend any of the mindfulness sessions, and failure to

attend postassessment) and were removed from the data set. Figure 1 describes the flow of study recruitment and participation. Students ranged in age from 18 to 24 ($M = 19.97$, $SD = 1.58$). The majority (66.7%) identified as women. The most common year in school was 1st year (36.1%), followed by 3rd year (22.2%). Regarding the race/ethnicity of participants, 58.3% identified as White or European American, 16.7% identified as Black or African American, 11.1% identified as biracial or multiracial, 8.3% identified as Hispanic or Latinx, 2.8% identified as Native American, and 2.8% identified as Asian American. Table 1 presents student demographics by intervention arm.

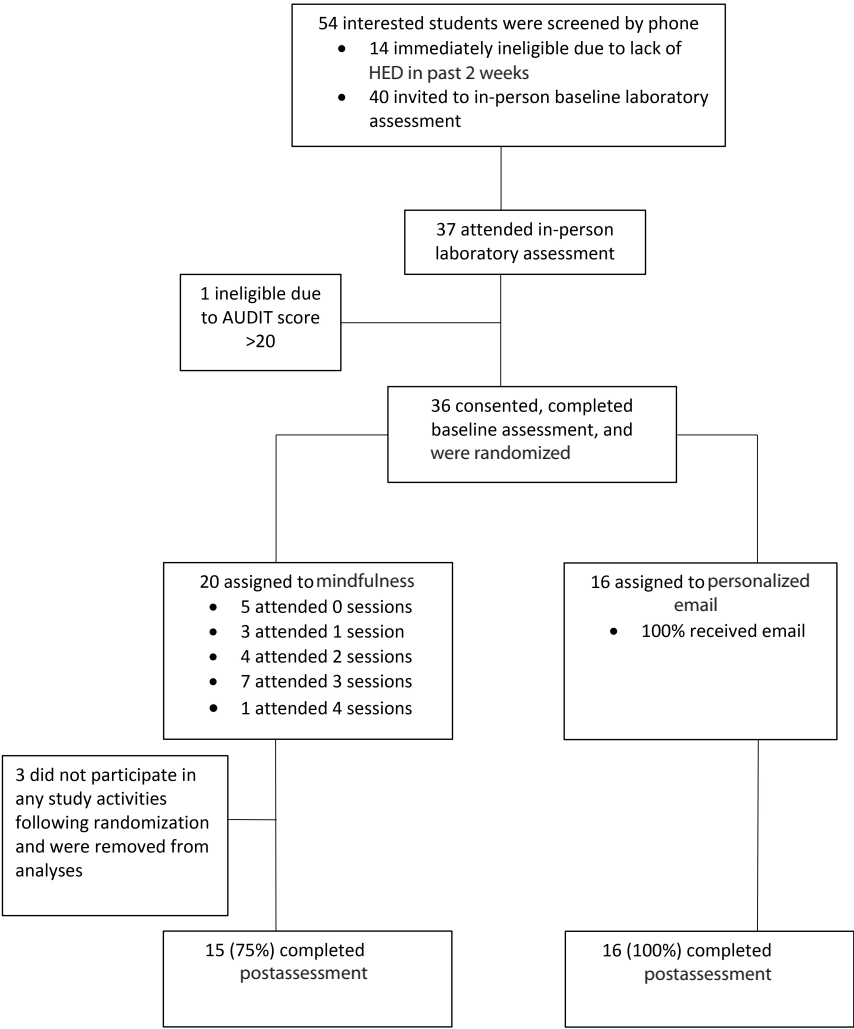


FIGURE 1
Study Participant Flowchart

Note. HED = heavy episodic drinking; AUDIT = Alcohol Use Disorders Identification Test.

Measures

Each measure described below was completed at baseline (1 week prior to the 4-week intervention) and postassessment (1 week following the 4-week intervention), unless otherwise stated. Participants received a \$20 Visa gift card each time they completed these measures (for a potential total of \$40 throughout the study).

Demographics. Participants were asked to report their date of birth, year in school, sex, and race/ethnicity. This measure was completed only at baseline assessment.

Daily Drinking Questionnaire. The Daily Drinking Questionnaire assesses alcohol consumption on a daily basis over the past month (Collins et al., 1985), including the number of standard drinks per drinking day and the number of hours drinking per week. Previous research has demonstrated high internal consistency of the measure in college students (Witkiewitz et al., 2014). The Cronbach's alphas in the current sample were .87 at both baseline and postassessment. Test-retest reliability was .89 for the number of standard drinks per day and .90 for the number of hours spent drinking per day.

Five Facet Mindfulness Questionnaire. The Five Facet Mindfulness Questionnaire (Baer et al., 2006) is a 39-item self-report measure of five facets of mindfulness: observing, describing, acting with awareness, nonjudgment, and nonreactivity (e.g., "I perceive my feelings and emotions without having to react to them"). It has established psychometric properties in young adult samples, including adequate internal consistency and criterion-related validity evidenced by negative associations of the subscales with measures of psychological distress and positive associations of the subscales with measures of emotional intelligence and well-being (Christopher et al., 2012; Pearson et al., 2015). In the current sample, the Cronbach's alphas for the subscales at baseline ranged from .74 (Observe)

TABLE 1
Sample Characteristics

Characteristic	Mindfulness Group (<i>n</i> = 17)		Email Group (<i>n</i> = 16)	
	<i>n</i>	%	<i>n</i>	%
Sex				
Male	6	35.29	4	25.00
Female	11	64.71	12	75.00
Year in school				
First	6	35.29	6	37.50
Second	3	17.65	2	12.50
Third	3	17.65	5	31.25
Fourth	2	11.76	1	6.25
Graduate student	3	17.65	2	12.50
Race/ethnicity				
Native American	0	0.00	1	6.25
Asian/Asian American	0	0.00	1	6.25
Black/African American	4	23.53	2	12.50
Hispanic/Latinx	2	11.76	1	6.25
White/European American	8	47.06	10	62.50
Biracial/multiracial	3	17.65	1	6.25

to .90 (Describe). The Cronbach's alphas for the subscales at postassessment ranged from .82 (Describe) to .92 (Nonjudge).

Perceived Stress Scale. The Perceived Stress Scale (Cohen et al., 1983) is a 10-item, widely used self-report measure of perceptions of psychological stress (e.g., "In the last month, how often have you felt nervous and 'stressed'?"). It has satisfactory psychometric properties in undergraduate samples, including adequate internal consistency (Hintz et al., 2015) and criterion validity demonstrated through positive associations with measures of depression ($r = .45$; Anastasiades et al., 2017) and anxiety ($r = .44$; Hintz et al., 2015). The Cronbach's alpha in the current sample was .78 at baseline and .75 at postassessment.

Negative Urgency subscale of the short version of the UPPS-P Impulsive Behavior Scale. The four-item Negative Urgency subscale of the short UPPS-P (i.e., Urgency, Premeditation [lack of], Perseverance [lack of], Sensation Seeking, Positive Urgency) Impulsive Behavior Scale (Cyders et al., 2014) was used to examine the tendency to engage in rash actions when experiencing negative affect (e.g., "When I feel bad, I will often do things I later regret in order to make myself feel better now"). Previous research has demonstrated the concurrent validity and internal consistency of this subscale in college samples (Cyders et al., 2014). The Cronbach's alphas in the current study for the Negative Urgency subscale ranged from .81 at baseline to .74 at postassessment.

Weekly mindfulness practice questionnaire. At the end of each week of the intervention, participants in the mindfulness arm were asked to report the number of minutes they engaged in mindfulness daily. Participants were encouraged to use the Koru Mindfulness app (Greeson et al., 2014) daily between sessions for at least 10 minutes and to review the minutes tracked on their app to enhance accuracy of this weekly tracking.

Satisfaction questionnaire. At the end of the 4-week intervention, participants in the mindfulness arm were asked to complete a brief questionnaire assessing satisfaction with and perceived efficacy of the program on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Participants also responded to a series of open-ended questions assessing challenges to participation and suggestions for improvement. Specific items included "What were the benefits of participating in this study?" "What were the challenges of participating in this study?" "What changes have you noticed in yourself after participating in this study?" and "What improvements would you suggest for future studies like this?"

Procedure

Prior to the start date, the research received approval from the institutional review board. Eligible participants who completed baseline assessment were randomized by ID number using the Research Randomizer website (<https://www.randomizer.org/>) to one of two groups: (a) a mindfulness intervention or (b) a personalized email providing tips to moderate drinking.

Mindfulness intervention. The mindfulness intervention consisted of four 60-minute sessions held weekly in a group format on campus. Each of the four group sessions was grounded in strategies from mindfulness-based stress reduction

(MBSR; Kabat-Zinn, 2003) and facilitated by the third and fourth authors, who have each received advanced training in MBSR and were leaders of a mindfulness program for students, staff, and faculty on campus. Session 1 focused on introducing the concept of mindfulness, setting group guidelines, practicing an awareness of breath meditation, and introducing the mindfulness app. Session 2 focused on performing a walking meditation, exploring motivations for drinking, examining the link between mindfulness and alcohol use, and reviewing home practice from the previous week. Session 3 focused on practicing breathing meditation, performing a loving-kindness meditation, writing a compassionate letter to oneself, and reviewing home practice from the previous week. Session 4 focused on a mindful eating exercise and an introduction of the STOPP acronym to reduce reacting impulsively in drinking situations (i.e., Stop whatever you are doing for a moment. Take several breaths. Observe what is happening right now. Purpose/Perspective: Ask yourself, what is my purpose, or, what is the big picture. Proceed: Given your purpose at that moment, what needs to happen? How can you choose a more helpful and positive response?).

Email intervention. Individuals in the email arm received a single personalized email during Week 1 of the intervention. This email was modeled on the work of Bryant et al. (2013) and was personalized on the basis of responses to the baseline assessment. Participants were provided with a comparison of their drinking habits (average number of drinks consumed and number of drinking days per week) with the actual drinking norms of students on campus (e.g., “According to the information you gave us, the number of occasions you drank was 3–4 times a week. The average amount you drank on each occasion was 5–6 drinks. The norm for students on our campus who drink alcohol is 1–2 times per week, drinking about four drinks on each occasion. A quarter of students haven’t had any alcohol in the past month”). Participants also received tips for moderating drinking (e.g., “Set limits by deciding how many drinks you are going to have ahead of time”); tips for moderating stress (e.g., “Find healthy ways to manage stress, like exercising or talking with friends and family”); and contact information for further campus resources.

Data Analysis Plan

IBM SPSS Statistics (Version 24) was used to complete all quantitative data analyses. Frequencies and descriptive statistics were used to assess attendance rates, retention rates, and each of the Likert-scale satisfaction questionnaire items. An analysis of variance was used to examine preassessment-postassessment differences in alcohol consumption, mindfulness, stress, and impulsivity for each group. We used a modified intent-to-treat approach (Gupta, 2011) in which participants who did not complete any aspects of the program after randomization were removed from the data set ($n = 3$). For participants who did enter an intervention arm but did not complete postassessment ($n = 2$), we used a last observation carried forward imputation. Thus, analyses were conducted using 33 participants. We used t tests and chi-square tests of independence to examine potential baseline difference

between students who dropped out and students who completed all aspects of the study. An analysis of covariance was used to examine differences postprogram between the mindfulness and personalized email intervention groups, controlling for baseline values of each variable. All effects were deemed significant at the $p < .05$ level. Responses to open-ended questions on the satisfaction questionnaire were reviewed by members of the research team for commonalities across responses, and representative quotes (both positive and critical) were selected.

Results

Attendance

Twenty students were assigned to the mindfulness arm, and 16 students were assigned to the email arm. Three students in the mindfulness arm did not complete any activities after randomization and were removed from the data set, leaving 17 in the mindfulness arm. Average attendance across the 17 participants was 2.06 sessions (51.47%). Two of the 17 students in the mindfulness arm (11.76%) did not attend any of the weekly mindfulness sessions. One participant (5.88%) completed all four sessions, seven participants (41.18%) completed three sessions, three participants (17.65%) completed two sessions, and two participants (11.76%) completed one session. Of the participants who attended at least one session, average attendance was 2.27 sessions (56.67%). Students stated that conflicting class and work schedules were major barriers to attendance.

Adherence to Mindfulness

Participants in the mindfulness arm were asked to participate in 10 minutes of mindfulness daily in between the weekly in-person sessions. The average minutes of mindfulness reported each week were 59.94 ($SD = 42.59$, range = 5–150) in Week 1, 69.00 ($SD = 34.51$, range = 15–150) in Week 2, 46.07 ($SD = 37.06$, range = 0–125) in Week 3, and 62.93 ($SD = 25.57$, range = 20–95) in Week 4.

Participant Satisfaction

Descriptive statistics were used to examine a range of satisfaction items ranked on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*), including the degree to which participants in the mindfulness arm enjoyed being a part of the program ($M = 5.80$, $SD = 1.21$), the degree to which participants believed their participation helped them to better manage their stress ($M = 4.87$, $SD = 1.51$), the degree to which the program helped participants to drink more moderately ($M = 4.00$, $SD = 2.07$), and the degree to which participants believed they could incorporate the material into their daily lives ($M = 6.07$, $SD = 1.22$). Qualitative comments describing program benefits, changes noticed after participation in the program, challenges of participation, and recommendations for future programs are included in Table 2.

TABLE 2
Sample Quotations From Mindfulness Group Participants
at Postintervention

Area	Sample Quotation
Benefits of the program	"I have learned how to manage my stress, especially during this stressful midterm period." "I understand better the concept of mindfulness, where before I only had a vague idea of it. I thought it was just meditation, but I discovered that you can apply it to anything in your life, such as walking or eating, and that's awesome because many of us just don't have time to meditate every day." "I now am more mindful in my day-to-day activities and am very conscious when my mind starts to spiral and when I need to take a step back and breathe." "Decreased drinking."
Changes noticed in self	"More open, optimistic, grounded." "I . . . take steps back to evaluate situations when I find myself getting stressed." "I have begun to drink less frequently." "I am more aware of how much/how little I have been drinking recently." "When I meditate, I am able to calm down faster." "I now take more time to calm down, breathe, and relax when stressed out." "I am able to calm myself when I begin to feel overwhelmed."
Challenges of the program	"At first, it was difficult to remember to practice mindfulness every day, but as time passed, I felt like I could do it almost daily (of course, there were some days I forgot), and there was a point when I often just did it without having to remind myself (while I was walking, mostly)." "Going to the weekly mindfulness meetings was hard—not because the actual event was hard, but rather because I had to keep reminding myself I needed to go." "Attending the sessions every week [was] challenging due to my work schedule." "The only barrier was having to get around my work schedule. Besides that, I really enjoyed it." "Not knowing how to meditate initially." "Forgetting to log my mindfulness minutes."
Recommendations for future programs	"The in-person meetings could've been shorter and [possibly] slightly more frequent." "The app for me is much easier because you get quicker, get into a daily habit of using it, while the in-person studies were [too] infrequent for me to get into a rhythm with it. I had to constantly try and remind myself I needed to go because it was not something that was part of my routine." "I prefer in-person meetings, as it forces me to sit down and be mindful." "Alternative session times. The app was good!" "The app really didn't do much for me. Maybe a biweekly half-hour meeting would have been more effective." "More in-person meetings/options for meetings." "Use a different app."

Outcome Measures

Two separate analyses of variance were used to examine within-group differences in alcohol consumption, perceived stress, mindfulness, and impulsivity from baseline to postintervention. Table 3 includes each measure, the mean baseline and postintervention assessment score, the effect size of the change, and the p value for each group. In the mindfulness group, the reduction in typical number of drinks on a weekend night was significant ($p = .025$). This was the only statistically significant within-group change.

An analysis of covariance was used to examine postprogram differences between groups on each of the variables of interest while controlling for baseline values. None of the group differences were significant. A large effect size

TABLE 3
One-Way Analysis of Variance of Alcohol Consumption, Stress, Mindfulness, and Impulsivity in the Mindfulness and Email Groups Before and After Participation in the Intervention

Variable	Preintervention		Postintervention		ES	p
	M	SD	M	SD		
Mindfulness group ($n = 17$)						
Typical number of weekend evening drinks	5.71	1.72	4.12	2.18	-0.97	.025
Largest number of drinks in past month	8.53	3.14	6.59	4.73	-0.48	.169
Typical number of drinks per week	13.06	9.45	10.32	8.63	-0.61	.385
Perceived stress	1.90	0.56	2.00	0.48	0.22	.579
Mindfulness						
Observing	26.58	5.30	27.18	5.46	0.19	.752
Describing	27.76	6.40	28.18	5.91	0.10	.847
Acting with awareness	27.76	5.24	26.71	5.49	-0.23	.569
Nonjudging	27.94	5.97	27.59	6.45	-0.21	.870
Nonreacting	20.29	5.77	21.59	5.11	0.43	.494
Impulsivity-negative urgency	2.41	0.88	2.40	0.75	-0.02	.958
Email group ($n = 16$)						
Typical number of weekend evening drinks	5.81	2.59	5.31	3.55	-0.23	.652
Largest number of drinks in past month	8.44	2.94	6.25	5.09	-0.52	.147
Typical number of drinks per week	12.09	6.67	10.63	7.12	-0.55	.551
Perceived stress	1.89	0.68	2.03	0.60	0.30	.566
Mindfulness						
Observing	29.37	5.28	29.43	4.76	0.02	.972
Describing	31.63	5.14	28.94	3.64	-0.54	.098
Acting with awareness	28.94	5.57	25.57	6.50	-0.87	.138
Nonjudging	27.60	8.38	26.20	7.63	-0.42	.636
Nonreacting	23.35	5.39	22.25	4.86	-0.55	.586
Impulsivity-negative urgency	2.22	0.76	2.45	0.69	0.44	.401

Note. ES = effect size (Cohen's d).

for the difference in typical number of weekend drinks between groups was observed (partial $\eta^2 = .55$), with greater reductions in the mindfulness group.

Discussion

Mindfulness interventions have shown promise to address a range of concerns in college students, including anxiety, stress, and substance misuse (Bamber & Morpeth, 2019; Falsafi, 2016; Mermelstein & Garske, 2015). Data from this pilot study suggest that aspects of a brief mindfulness intervention to reduce HED were satisfactory among college students, although modifications will be needed to enhance engagement. After completing the intervention, participants were asked to provide feedback regarding their thoughts about the program and its perceived benefits. Students described how mindfulness enhanced their ability to manage emotions and stressful situations, in line with previous qualitative research on mindfulness in college students (Kerrigan et al., 2017). Ratings for ability to incorporate mindfulness material into daily life and program enjoyment were the highest rated items on the Likert-scale portion of the satisfaction survey. Of importance, items focused on the program's ability to help students manage drinking and stress were scored at the midpoint of the scale—perhaps because of the brevity of the program. Indeed, the traditional MBSR program consists of 26 hours across eight sessions (Kabat-Zinn, 2003), and the majority of successful mindfulness-based interventions aimed at substance misuse consist of at least 16 hours of formal programming in addition to home practice (Li et al., 2017). Perhaps a longer intervention would have enhanced participant perceptions of reduced stress and ability to regulate alcohol intake, although a brief, 4-week intervention has reduced stress in another university sample (Greeson et al., 2014). Of note, longer mindfulness interventions might not be feasible within counseling centers that have implemented session limits to address increasing student need amid limited resources (Coleman et al., 2021). Providing an intervention to students that allows for technology-based tools (such as the Koru Mindfulness app) as a supplement to in-person sessions could be advantageous for college counseling centers.

Attendance rates combined with data from the satisfaction survey revealed student barriers to attending the in-person mindfulness sessions. Several participants mentioned conflicting work and school schedules as the greatest barriers for mindfulness session attendance, which is typical of college students who are often balancing school, work, and social commitments. Canby et al. (2015) implemented a six-session MBSR intervention for college students in which participants attended over 80% of the sessions. In contrast to the present study, this intervention was offered as a college course for credit and included more formal lectures and group activities. Future programs should consider incentives for session attendance, such as course credit, along with more flexible meeting schedules for participants and alternative meeting formats, such as computer- and app-based interventions. With the rapid development of technology and the growing interest in mobile and electronic health applications to deliver mindfulness interventions (Spijkerman et

al., 2016), researchers and college counseling centers should continue to explore these methods as alternatives to face-to-face meetings.

Following the 4-week intervention, participants randomized to the mindfulness intervention displayed a significant within-group reduction in the number of drinks consumed on weekend nights. This finding is important, because weekends are when students drink the most, with the exception of certain holidays or birthdays (Neighbors et al., 2011). The effect size for this change was large, essentially reducing average weekend night alcohol consumption by over 1.5 drinks. Although promising, this finding should be interpreted with caution given the small sample size and relatively low attendance rates of in-person sessions. It is also possible that the reduction in alcohol consumption might have been associated with fluctuations in drinking patterns in response to increasing academic demands during the spring semester. A previous study found that 1st-year students' alcohol consumption was higher at the beginning of the semester and lower at the end of the semester, during examination periods (Tremblay et al., 2010). Although no other changes were significant, the large and medium effect sizes observed across change in alcohol intake in the mindfulness group are promising, particularly given the brevity of the intervention.

Participants in the mindfulness arm did not show a significant increase in mindfulness. This finding is in contrast with prior studies with college students that have yielded increases in dispositional mindfulness following a brief intervention (Greeson et al., 2014; Mermelstein & Garske, 2015). Our finding could be a result of the poor attendance of in-person sessions among participants or the progressing intensity of student workload throughout the college semester. Anecdotally, participants reported increased stressors related to midterms and coursework, which might have weakened their perceptions of their ability to be mindful. Although the changes were not statistically significant, from baseline to postintervention, the email group reported reductions in the mindfulness facets of acting with awareness, nonjudging, nonreacting, and describing, along with more impulsivity, with effect sizes ranging from medium to large. It is possible that the skills learned in the mindfulness group served as a buffer as stressors mounted (Creswell & Lindsay, 2014).

Limitations

One weakness of the present study is the potential lack of generalizability of the intervention to diverse college students, given that 66.7% of the participants in our study identified as women and 58.3% identified as White or European American. This study also failed to collect other relevant student demographic information, such as involvement in athletics or Greek life, which might have influenced the frequency of drinking episodes. Furthermore, the study failed to control for exposure time between our two intervention arms, in that the control group received a single email in the span of the 4-week intervention, whereas the mindfulness group received a total of 240 minutes in communication with mindfulness facilitators. Additionally, we did not confirm whether participants in the personalized email feedback group reviewed the content that was sent in the email (e.g., by requesting a read receipt). An

additional weakness of the study is the potential for social desirability bias, in that students were aware of the purpose of the study and might have reported reduced drinking habits to please the research team. Finally, all findings must be considered in light of the small sample size.

Directions for Future Research

Future studies should examine the feasibility of mindfulness interventions in diverse college samples and use attention-matched control groups. To reduce concerns regarding self-report data, future research should incorporate more objective measures of alcohol use, such as measuring blood alcohol content via a smartphone app. Future studies might also consider specifically targeting students who report high levels of stress and impulsivity, given that more targeted mindfulness interventions for students who display these risk factors for HED might have greater efficacy. Finally, an extended follow-up is needed to gather data on the long-term effects of such interventions.

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