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Perceptions of Heavy Drinking College Students about a Sleep and Alcohol Health Intervention

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Abstract

The purpose of this mixed methods study was to describe the sleep and psychological characteristics of heavy drinking college students, their perceptions of sleep and sleep/alcohol interactions, and their reactions to a proposed integrated sleep and alcohol internet-based intervention. Students (N = 24) completed standardized surveys and participated in semi-structured focus group interviews. Participants reported a high degree of sleep disturbance, sleep obstacles, and sleep-related consequences, which were validated by both quantitative and qualitative investigations. Sleep disturbance and sleep-related impairment were associated with more frequent drinking and greater risks from drinking. Participants perceived that alcohol has positive and negative effects on sleep latency, continuity, and quality. They expressed overall enthusiasm for the intervention but had specific content and format preferences.

Introduction

Sleep disturbance and heavy drinking are among the most common problems that college students in the United States report (Blanco et al., 2008; Gaultney, 2011). An estimated 70% of college students report disturbances in sleep including short sleep duration and excessive daytime sleepiness, irregular sleep schedules (i.e., inconsistent bed/wake times), and poor self-reported sleep quality (Lund, Reider, Whiting, & Prichard, 2010). More specifically, college students sleep an average of 7 hours per night (Lund et al., 2010), below recommended guidelines for adolescents (i.e., 8.5-9.25 hours) (Bonnet & Arand, 2011), and approximately 20% report staying up all night at least monthly (Lund et al., 2010). Further, the sleep schedules of college students are highly variable. Many college students prioritize academic and social commitments over sleep during the week and then sleep longer on the weekend. This variability in sleep scheduling puts them at increased risk for delayed sleep phase disorder (Kloss, Nash, Horsey, & Taylor, 2011). Heavy drinking in college is nearly

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as ubiquitous as sleep disturbance. Nearly half of all college students report heavy, episodic drinking (i.e., 5 drinks on 1 occasion for men, 4 for women) (SAMSHA, 2006). College students also have elevated rates of alcohol use disorders (i.e., roughly 20%) (Blanco et al., 2008; SAMSHA, 2006), the peak onset of which occurs during young adulthood (Grant et al., 2004).

Sleep disturbance and heavy drinking may function as a negative feedback loop. Alcohol consumed 30-60 minutes before bedtime reduces sleep onset latency and consolidates sleep during the first half of the night at both high and low doses but fragments sleep during the second half, particularly at high doses (Ebrahim, Shapiro, Williams, & Fenwick, 2013; Roehrs & Roth, 2001). At drinking levels frequently reported by young adults (i.e., 0.75 mg/kg which is greater than 4 standard drinks), alcohol also decreases REM sleep and REM sleep onset (Ebrahim et al., 2013). Moreover, higher alcohol use among college students is associated with lower sleep duration, greater sleep schedule irregularity, bedtime delay, weekend oversleeping, and sleep-related impairment (DeMartini & Fucito, 2013; Singleton & Wolfson, 2009). In turn, poor sleep quality may promote alcohol use to induce sleep (Brower, 2003; Roehrs & Roth, 2001). Indeed, alcohol consumption is higher among individuals who report less sleep (Roehrs & Roth, 2001). Nearly a quarter of individuals with insomnia and roughly half of alcoholics report use of alcohol to aid sleep (Brower, 2003; Johnson, Roehrs, Roth, Breslau, 1998). Among college students, greater sleep disturbance predicts more frequent and heavier drinking and the use of alcohol to induce sleep (Kenney, LaBrie, Hummer, & Pham, 2012; Lund et al., 2010; Taylor & Bramoweth, 2010).

Both sleep disturbance and heavy drinking have negative effects on mental and physical health, academic performance, and increase injury risk including motor vehicle accidents, among the leading causes of death in this age group (Gaultney, 2011; Hingson, Zha, & Weitzman, 2009; Millman, 2005; Park, 2004; Park, Mulye, Adams, Brindis, & Irwin, 2006; Singleton & Wolfson, 2009; Taylor & Bramoweth, 2010; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994).

In fact, sleep disturbance may be a risk factor for developing an alcohol use disorder (Brower, 2003). In prospective studies, sleep disturbance during childhood has been shown to predict early onset of alcohol use during adolescence (Wong, Brower, Fitzgerald, & Zucker, 2004). In addition, recent evidence suggests that sleep disturbance and heavy drinking among college students in combination may have a synergistic effect (DeMartini & Fucito, 2013; Kenney et al., 2012). For example, heavy drinking college students who report greater sleep disturbance experience more alcohol-related consequences (e.g., blackouts, interpersonal problems) than their heavy drinking counterparts who report good sleep (Kenney et al., 2012).

Psycho-educational sleep interventions for college students include education about sleep stages and circadian rhythms, sleep hygiene, strategies to create a sleep-conducive environment, and/or relaxation/mindfulness techniques (Brown, Buboltz Jr, & Soper, 2006; Gellis, Arigo, Elliott, 2013; Kloss et al., 2011; Trockel et al., 2011). Some interventions also incorporate cognitive strategies to reduce maladaptive sleep beliefs (Brown, Buboltz, &

Soper, 2002; Gellis et al., 2013; Trockel et al., 2011). These components are also part of cognitive-behavioral therapy for insomnia (CBT-I), an empirically validated treatment that results in medium to large improvements in insomnia symptoms (Edinger et al., 2001; Morin et al., 2009) and is effective in brief (Edinger & Sampson, 2003) and computer-based formats (e.g., SHUTi, RESTORE™) (Ritterband et al., 2009; Vincent & Lewycky, 2009). Likewise, college sleep interventions have medium to large effects on sleep quality and important sleep correlates (e.g., depressive symptoms) (Brown et al., 2002; Gellis et al., 2013; Trockel et al., 2011) and are effective when computer-based (Trockel et al., 2011) or delivered in brief formats (Gellis et al., 2013). Sleep hygiene education may briefly address limiting alcohol use before bedtime, (Stepanski & Wyatt, 2003) however, this information alone is not effective in reducing heavy alcohol use.

Individual-level alcohol interventions for college students emphasize increasing motivation and commitment to change drinking (Cronce & Larimer, 2011). Common components include education about alcohol, personalized feedback about students' drinking patterns, alcohol-related problems, beliefs about alcohol, and motives for drinking, and specific strategies for reducing alcohol use and alcohol-related harm (Cronce & Larimer, 2011). These interventions are efficacious for reducing alcohol use and alcohol-related problems with effect sizes in the small to medium range (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Cronce & Larimer, 2011). They are most effective if personalized feedback about the student's drinking is provided relative to age-related norms (Cronce & Larimer, 2011). Moreover they can be delivered effectively using computer-based and brief, single session in-person formats (Bersamin et al., 2007; Carey, Scott-Sheldon, Elliott, Bolles, & Carey, 2009; Dimeff & McNeely, 2000; Hester et al., 2012; Kypri et al., 2004; Saitz et al., 2007; Walters et al., 2006). In contrast, general health interventions that do not include alcohol-specific information are not effective for reducing drinking and alcohol-related problems in college students (Carey et al., 2007; Cronce & Larimer, 2011). Therefore, a sleep intervention is not likely to be effective for reducing drinking and drinking-related consequences in college students. By the same token, alcohol interventions do not typically incorporate sleep information and a reduction in drinking may not be sufficient for improving sleep in this group.

Given the substantial co-morbidity of sleep disturbance and heavy drinking among college students, the bi-directional effects of sleep and alcohol use, and the fact that college students are unlikely to seek specialty alcohol treatment (Black & Coster, 1996), treatment integration makes sense. Young adulthood, and college in particular, is an ideal time to intervene on heavy drinking to prevent the development of chronic alcohol use disorders (Zucker et al., 2006). However, most heavy drinking college students do not seek alcohol treatment and may be reluctant to change their drinking (Black & Coster, 1996). College students are, however, open to health interventions, such as sleep treatment, (Orzech, Salafsky, & Hamilton, 2011) and limiting alcohol use near bedtime is already a component of sleep hygiene education (Stepanski & Wyatt, 2003). Expanding the alcohol-specific content in a sleep intervention to include personalized feedback, moderate drinking recommendations, and drinking reduction strategies may be an effective college drinking intervention, as this model does not rely on self-identification for alcohol treatment.

The purpose of this mixed methods study was to understand heavy drinking college students' sleep and drinking behaviors and their reactions to a proposed integrated sleep and alcohol internet-based intervention to inform intervention development. The aims were threefold: (1) to describe the self-reported sleep and psychosocial characteristics (i.e., depression, anxiety, health risk behaviors) of heavy drinking college students who report having sleep concerns, (2) to characterize heavy drinking college students' perceptions of sleep and the association between sleep and alcohol use and (3) to describe heavy drinking college students' reactions to a proposed integrated sleep and alcohol intervention.

Method

Design

A mixed-methods descriptive design was used (quantitative + qualitative) (Creswell & Plano Clark, 2011). Participants were heavy drinking college students who were at risk of harm from their alcohol use and who reported sleep concerns. Participants completed standardized surveys and participated in semi-structured focus group interviews. Data were collected and analyzed for each qualitative and quantitative strand individually and then integrated in the discussion.

Participants and Procedure

College students were recruited during the Spring 2013 semester from local colleges primarily through advertisements on Facebook, flyers posted around campuses, and announcements emailed to college administrators/faculty. Advertisements targeted college students with sleep problems and stated that the purpose of the study was to conduct interviews with college students about their sleep habits and possible interventions for sleep difficulties. Study ads directed students to the study website which informed them that the study was designed to understand the relationship between sleep disturbance and alcohol consumption in college students with the ultimate goal of developing a new sleep intervention for college students. To be eligible for the study, participants had to report the following: (1) concerns about sleep (dichotomous: yes/no), (2) 1 heavy drinking occasion (s) in the past month (i.e., 5 drinks on 1 occasion for men; 4 for women), and (3) risk of harm from drinking based on an AUDIT-C score of 7 for men; 5 for women.

Interested volunteers who clicked on web-based advertisements or contacted study staff were first directed to the study website to complete a web-based pre-screener that took approximately 5 minutes. Individuals who met initial eligibility were then invited to participate in an in-person intake appointment of approximately 45-60 minutes, to verify final eligibility and assess demographic information and sleep and drinking characteristics. Eligible participants were then assigned to participate in 1 of 5 focus group interview sessions that took place immediately following or up to 3.5 weeks after intake. Focus group sessions were composed of 4-7 participants who were interviewed as a group (i.e., interview sessions 1-4); one participant who was unable to attend any group session completed an individual interview (i.e., interview session 5). In interview sessions 1-4, we asked each participant to provide his/her opinion on a given discussion topic by raising his/her hand in agreement so that we could get an estimated count of students' perceptions and preferences.

Quantitative Measures

All measures were computer-based. Data were collected on sleep, alcohol use, psychosocial well-being, and health risk behaviors.

Sleep—For the internet-based pre-screener, potential participants indicated whether they had any concerns about their sleep using a dichotomous variable (i.e., “yes” or “no”) created for this study.

The Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989), a 19-item measure, was used to assess total self-reported sleep disturbance using the global PSQI score and quantitative sleep characteristics using the sleep duration and sleep latency subscales. The PSQI is a reliable, valid tool for detecting “good” versus “poor” sleepers. Suggested cut-off scores for the total PSQI include 5 and 7 with higher scores indicating poorer self-reported sleep (Buysse et al., 1989; Gellis & Lichstein, 2009).

The 8-item NIH Patient Reported Outcomes Measurement Information System Sleep-Related Impairment Short-Form (PROMIS-SRI-SF) (Yu et al., 2011), a reliable, precise measure that allows for normative comparisons, assessed qualitative aspects of sleep wake function (e.g., perceptions of sleepiness, functional impairments due to sleep problems) using the total score. Raw total scores are converted into standardized scores using a T score with a mean score of 50 and standard deviation of 10. The PROMIS-SRI-SF was calibrated on a U.S. sample slightly enriched for chronic illness so a score of 50 is representative of a somewhat more impaired population than the general U.S. population (Yu et al., 2011).

The Composite Scale of Morningness (CSOM) (Smith, Reilly, & Midkiff, 1989), a 13-item, reliable, valid measure of circadian preference, evaluated participants' chronotype. Using the total score, participants' chronotype were coded as follows: (1) 44-55 = morning type, (2) 23-43 = intermediate type, and (3) 22 or less = evening type.

The Cleveland Adolescent Sleepiness Questionnaire (CASQ) (Spilsbury, Drotar, Rosen, & Redline, 2007), a reliable self-report tool that corresponds with other validated sleepiness measures, assessed excessive daytime sleepiness and sleep-related impairment typical in this population using a total score (maximum possible score = 80).

Alcohol—The Daily Drinking Questionnaire (DDQ) (Collins, Parks, & Marlatt, 1985) assessed alcohol use starting from the month prior to and including the assessment day. We used a 7-day grid to assess typical week drinking based on the following standard drink definition: 12-oz. beer, 5-oz. of wine, or 1.5-oz. of hard liquor (straight or in a mixed drink), all equivalent to approximately 0.6oz. or 14g of pure alcohol (NIAAA, 2010). To determine the total number of drinks participants consumed during a typical week, we summed the total number of drinks reported on the grid.

The Alcohol Use Disorders Identification Test (AUDIT) is a brief, standardized screener for hazardous drinking and alcohol use disorders (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998). Scores on the AUDIT Consumption Subscale (AUDIT-C) of 7 and 5 for men and

women, respectively, have been identified as optimal cut-off scores for identifying at-risk drinking in college students (Demartini & Carey, 2012).

The Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ) is a 24-item self-report assessment of alcohol-related problems in the past 30 days (Kahler, Strong, & Read, 2005). Items are tailored for a collegiate population and include driving while intoxicated, unplanned sexual activity, and blacking out. Items were summed to create a total number of problems score for each participant.

Psychosocial—The NIH PROMIS Anxiety (7-item)& Depression (4-item) Short Forms (Pilkonis et al., 2011), both valid measures of emotional well-being that allow for normative comparisons, assessed participants' fear, anxious misery, hyper-arousal, negative and positive mood. Raw total scores are converted into standardized scores using a T score; a mean score of 50 represents the average for the U.S. general population (standard deviation = 10).

Select items from the Centers for Disease Control National College Health Risk Survey (Douglas et al., 1997), a survey of health risk behaviors that contribute to morbidity and mortality among youth and young adults, assessed participants' potential for unintentional injury (e.g., riding as passenger with a drunk driver, driving under the influence of alcohol).

Qualitative Interviews

Interviews were conducted using a semi-structured template and encompassed three domains: (1) perceptions of sleep difficulties, sleep-related consequences, and sleep-related barriers in college; (2) perceptions of the connection between sleep and alcohol use; (3) reactions to a proposed integrated, internet-based sleep and alcohol intervention (see Table 1). We ceased recruitment when interviews yielded no new information about the three domains and there was redundancy in sub-themes.

Two investigators with extensive experience providing health interventions to college students conducted the interviews (LMF, KSD) along with a research assistant. Interviews lasted approximately 90 minutes and were audiotaped. To protect participants' confidentiality, participants were asked to use a pseudonym during the interview. An external transcription service then transcribed audiotaped interviews verbatim; digital interview files were uploaded using a secure, password-protected server.

Data Analysis

Quantitative methods were used to summarize participant self-report data. Pearson correlations were conducted to identify potential associations among sleep, alcohol, and psychosocial measures. It was hypothesized that more frequent and/or higher quantity of alcohol use (DDQ) and higher alcohol-related problems (AUDIT, BYAACQ) would be associated with more self-reported sleep disturbance (PSQI total score), sleepiness (CASQ), sleep-related impairment (PROMIS-SRI), depression, and anxiety (PROMIS-Anxiety, PROMIS-Depression). We anticipated that sleep outcomes would be associated with alcohol outcomes even when controlling for potential associations with depression and/or anxiety. Mann-Whitney *U* tests were also conducted to examine whether participants who reported

ever riding with a drunk driver as a passenger or driving under the influence, differed on sleep measures (PSQI, CASQ, PROMIS-SRI, CSOM) from their less risky counterparts. It was anticipated that health risk behaviors would be higher among participants who reported more sleep disturbance, sleepiness, and/or sleep-related impairment and among those who reported an evening chronotype.

Transcribed interviews were analyzed using QSR International's NVivo 10 (QSR, 2012), a qualitative software program that facilitates text coding and comparison across participants. Interview transcripts are uploaded into NVivo and then text components can be assigned codes. NVivo assigns codes that are identified by the investigator. Three investigators analyzed interview content (coding team = LMF, KSD, THH) using a constant comparative method in which data was broken down into discrete units and then coded into relevant categories (Sandelowski, 2000). A preliminary thematic coding infrastructure was first derived from the three aforementioned domains of the semi-structured focus group interviews; data for each question was first coded into its relevant domain. For example, a participant's narrative about having trouble sleeping and tossing and turning throughout the night was first coded in the "sleep difficulty" domain. The coding team reviewed coded transcripts in detail to determine whether the data were initially categorized in the appropriate domain. Data within each domain were then coded, using line-by-line coding of participant's statements. These codes were further specified into secondary themes after multiple readings of the data in which the team investigated sub-topics, opposing opinions, and new insights. The relevance of domains and sub-themes was evaluated using repeated comparative assessment until thematic saturation had been reached (i.e., no further themes could be derived). For example, a participant's narrative about having trouble sleeping and tossing and turning throughout the night was further coded as "sleep difficulty, trouble staying asleep." Coding reliability was maintained through initial group review of transcripts and thematic infrastructure development, preliminary roundtable discussions concerning the interpretation and application of themes, and group consensus on coding scheme and working definition of codes and themes.

Results

Participants

Participants were twenty-four undergraduate students from five local colleges and universities. Participants were 19.96 years old on average ($SD = 1.52$) and the majority were Caucasian (75%), and female (54%). Participants were evenly distributed across classes – freshman (21%), sophomores (33%), juniors (29%), and seniors (17%). A small percentage of participants reported being members of fraternities or sororities (21%). A third of the sample reported *ever* using alcohol to induce sleep. On average, participants reported heavy drinking on approximately 3 days per week and experiencing a high number of drinking-related consequences (see Table 2). Of particular concern, many participants reported driving after drinking (29%) and most reported riding as a passenger with a drunk driver (54%). Participants had elevated anxiety scores with an average score nearly 1 standard deviation above the general U.S. population. In contrast, their depression scores were within the average U.S. population.

Associations among Sleep, Alcohol, Psychosocial Outcomes

Depression scores were significantly correlated with PROMIS anxiety [$r(24) = .80, p < .001$], PROMIS sleep-related impairment [$r(24) = .74, p < .001$], PSQI total sleep disturbance [$r(24) = .63, p < .001$], and CASQ sleepiness scores [$r(24) = .41, p = .04$], and there was a non-significant trend suggesting an association with BYACCQ alcohol-related consequences [$r(23) = .39, p = .07$]. In addition, both PSQI total sleep disturbance [$r(24) = .41, p = .05$] and PROMIS sleep-related impairment scores [$r(24) = .54, p = .01$] were significantly associated with typical number of drinking days on the DDQ. Partial correlations were then conducted, controlling for PROMIS depression scores. Only the correlation between PROMIS sleep-related impairment and frequency of drinking on the DDQ remained significant after controlling for depression [$r(20) = .52, p = .01$]. The results of Mann-Whitney U tests also revealed that participants who reported ever riding as a passenger with a drunk driver had significantly higher sleep-related impairment scores [Mean Rank = 18.50] than their less risky counterparts [Mean Rank = 10.50; $z = -2.41, p = .02$].

Qualitative + Quantitative Results

For each domain (i.e., perceptions of sleep and sleep/alcohol interactions, reactions to integrated intervention), participants described several themes that were further divided into subthemes where relevant. Illustrative quotes for each theme are provided below.

Domain 1: Perceptions of Sleep Difficulties, Sleep-Related Consequences, and Sleep-Related Barriers in College – Main Themes

Common sleep problems: On average, participants reported sleep durations of 6.65 hours per night and a sleep onset latency of nearly 40 minutes (see Table 2). Participants also reported a high level of sleep disturbance as demonstrated by an average score of 9 on the PSQI. No participants reported a morning chronotype; most had an intermediate circadian preference. In focus group discussions, many participants stated that they have difficulty falling asleep or staying asleep. Most also indicated sleeping for short durations and maintaining sleep schedules that differed on weekdays and weekends. Most participants also described their sleep quality at college as poor.

“I find myself tossing and turning a lot through the night, waking up having to go to the bathroom in the middle of the night or getting really hot at night, so just like tossing and turning and not being able to go back to sleep.”

“On the weekends, say I drank the night before, I might get up at 12 or 1, but then during the week I will probably get up at 7:20 if I have an 8 am. So I think it just really depends on what is going on.”

Sleep-related consequences: Participants reported high scores on measures of sleepiness and sleep-related impairment (see Table 2). These quantitative findings corresponded with participants' focus group discussions. The most common sleep-related consequence participants discussed was excessive daytime sleepiness (e.g., falling asleep in class, missing classes due to oversleeping). Many participants also stated that sleep disturbance reduced

their efficiency and productivity and caused negative mood changes. Some also indicated that it interfered with their ability to practice good self-care (i.e., exercise, nutrition).

“I fall asleep during class ... like I can feel it too. I'm just sitting there, trying to take my notes, and all of a sudden like my eyes, my eyelids start getting really heavy.”

“If I obviously got better sleep and slept better throughout the night, I would be able to wake up, concentrate more, and just be able to get things done quicker and more proficient and stuff like that, so I feel like if I had better sleep, it would just be easier for me.”

Sleep barriers: In focus groups, some participants stated that technology (i.e., TV, computers, smartphones) interfered with their sleep. Many participants also identified several college-specific environmental factors as major sleep barriers such as roommate disruptions, uncontrollable dorm room temperatures, dorm room lighting, and ambient noise. Many respondents also stated that both positive and negative aspects of the “college experience” (e.g., socializing, stress) disrupt sleep.

“My roommate's up like [until] 3:00 or 4:00 in the morning. She's on the phone all the time and I think that makes me wake [up] because I'm used to sleeping in this quiet and dark place and she's used to sleeping with TV all night so it's like we have a different lifestyle.”

“This is supposed to be the best 4 years of your life, so why sleep?”

Sleep-promoting strategies: The most common strategy participants identified to promote sleep in interviews was the use of over-the-counter (OTC) or prescription sleep aids or illicit drugs. Sleep aids included antihistamines, nighttime OTC cold remedies or pain medications, benzodiazepines, and opiates. Few participants discussed current use of alcohol to induce sleep. Many participants indicated that they use behavioral strategies to promote sleep such as white noise machines, room darkening shades, smartphone sleep applications, exercise, or relaxation techniques.

“I usually need a fan too, just background noise. It can't be dead silent and then also I would hear my suitemates if it's not noisy in my room.”

“Zzzquil™ works, I think. I tried drinking tea like non-caffeine tea just to kind of calm me down but that doesn't work so I usually take Zzzquil™ as well or like other prescribed medication.”

Domain 2: Perceptions of Alcohol/Sleep Interactions – Main Themes

Falling asleep: Many participants stated during interviews that they fall asleep faster after a night of drinking either due to the direct sedating effects of alcohol or because they are less likely to delay sleep because of use of smartphones, computers, or other technology.

“Yeah, like you will be out and you will get back and just be so tired. You can change quickly, go to bed, and fall asleep. I won't even go on my phone. I will just go to sleep.”

“If I drink, I sleep so well. I don't wake up so, for me, somehow drinking on the weekends helps me to get sleep. I couldn't sleep during the weekdays and weekends I party and drink and I feel better, actually, because I can sleep well.”

Staying asleep: In focus groups, participants were split in terms of their perceived effects of alcohol on sleep continuity. A few participants indicated that alcohol helps them stay asleep until their preferred wake time or later in the morning. Conversely, many others stated that alcohol wakes them up much earlier than they preferred and causes hangovers. As a result, the latter participants indicated that they attempt to go back to sleep later in the morning and then have difficulty being active during the rest of the day.

“I feel like I will have the worse hangover and maybe I will wake up at like 8 but I won't be able to get out of my bed until 11 or 12. It's just the worst feeling. If I for some chance have a class, I won't feel like taking notes at all. And I won't really comprehend everything as well that I'm learning.”

Overall sleep quality: Participants were also divided on their perceptions of how alcohol affects sleep quality in interview discussions. Some discussed positive effects of alcohol on sleep quality (e.g., facilitate falling/staying asleep) whereas many others indicated that alcohol had a negative effect (e.g., cause vivid dreams, frequent awakenings, shallow sleep).

“I think that I get worse quality of sleep when I drink so I'll wake up at like 7:00 in the morning, even if I stayed out until 2:00 or 3:00 the night before just because I'm sobering up and then I'll have difficulties falling back asleep.”

Domain 3: Integrated Intervention Perceptions and Preferences– Main Themes

Interest: Most participants expressed being open to trying an integrated sleep and alcohol intervention during interviews but some stated that their overall interest would depend on the specific content and structure of the program. Some expressed ambivalence about their willingness to remain engaged in the program for several weeks.

“I think a lot of college students, they're probably quite aware that their sleep pattern is poor but they think that's just like a consequence of their lifestyle that they have and they're not prepared to sacrifice their schoolwork/social experience....but if there's something whereby they could see how poor their sleep might be...I think it would be pretty successful for the web-based [program].”

Preferred content: During focus group interviews, most participants expressed interest in the sleep and sleep/alcohol interaction proposed content of the intervention. Many were also interested in learning more about the association between sleep and alcohol use and a few thought information about the combined risks of sleep deprivation and heavy alcohol use would be very helpful. Many participants were less enthusiastic about the brief alcohol intervention unless it had a sufficient rationale for sleep, emphasized harm reduction, and/or provided content that was uniquely different from other alcohol interventions students already receive. For the treatment of sleep problems and heavy alcohol use, most participants preferred specific, tailored feedback and personalized strategies to change their behaviors. Some participants also stated that it would be useful for the intervention to

provide tools that could be used outside of the web-based program (e.g., personalized blood alcohol chart).

“As long as it didn't like appear deceptive, I think if I went on a website to help my sleeping patterns and then it turned into an alcohol thing, I would kind of be like this isn't right.”

“The combination would be nice because we already know what alcohol is gonna do to us and we've been told since we were like 5 years old by our parents that drinking is bad and we know about that, it's just the combination would be new information to us. Like the example, you might actually be more likely to fall off the curb when you're walking if you might have sleep deprivation and you're drinking.”

Preferred structure/format: In focus group interviews, most participants preferred an intervention with brief assessments that could tailor health information to them specifically rather than general health information. Most also preferred interventions that would allow modules or information to be accessed quickly based on choice rather than requiring content to be accessed in a particular order. Many participants favored the provision of new, brief tips of the day to keep interest; some also liked the ability to track one's progress. Many participants thought the option for peer support or clinician contact (via phone or email) would be helpful. Almost no participants preferred content to be delivered via video clips.

“I think if you have one of those interactive surveys where it gets your personalized information, I don't think have the survey too long, maybe just where you could get a basic thing of what's wrong with you.”

“I think kind of like Snapple cap too like little fun facts that would be interesting so you just go on to the website and it's something at the top of the page that's changed everyday.”

Discussion

The purpose of the study was to understand the sleep and psychosocial characteristics of college students who are heavy drinkers and their perceptions of sleep and sleep/alcohol interactions to inform the development of an integrated internet-based sleep and alcohol intervention. Participants reported a high degree of sleep disturbance in line with prior studies with college students (Lund et al., 2010). Typical sleep problems included short sleep duration, irregular sleep schedules (i.e., inconsistent bed/wake times on weekdays vs. weekends), poor self-reported sleep quality, and difficulty initiating or maintaining sleep. Of note, participants' sleepiness and sleep-related impairment scores exceeded those of normative samples. For instance, their Cleveland Adolescent Sleepiness Questionnaire average score of 40.58 exceeded the sleepiness level reported by adolescents with known sleep problems (Spilisbury et al., 2007). In a prior study, adolescents with sleep apnea and primary snoring had average CASQ scores of 37.7 and 35.0 respectively compared with adolescents without a known sleep problem who had average scores of 12.2. In regard to sleep-related impairment, participants scored on average 1 standard deviation higher than the general U.S. population. Participants also identified a number of barriers that interfered

with sleep, many of which were typical of the college experience. A common sentiment among participants was that academics and social activities are prioritized over sleep. Participants also reported a number of sleep-related consequences as a result of their sleep problems, the most common being excessive daytime sleepiness that interfered with school performance. Other sleep-related impairments included negative mood and poor self-care. These findings are consistent with prior studies on sleep barriers and sleep-related impairment in college (Lund et al., 2010). To promote sleep, participants reported relying primarily on pharmacological interventions (i.e., OTC or prescription sleep aids, illicit drugs). Some participants also tried technology-based sleep aids (e.g., smartphone apps), relaxation techniques, and/or strategies to make their sleep space more sleep-conducive. In general, participants seemed to accept that sleep disturbance was a fact of college life.

In this college sample selected for current heavy drinking and sleep concerns, those who reported more sleep disturbance and sleep-related impairment drank alcohol more frequently and took more health risks. This finding confirms recent research that showed poor self-reported sleep quality was associated with greater harm from drinking among college students who reported heavy drinking (Kenney et al., 2012). Sleep disturbance may render heavy drinking college students more vulnerable to alcohol-related risks due to its impairment of executive functioning (Kenney, Lac, Labrie, Hummer, & Pham, 2013).

Three themes best described participants' perceptions of the connection between sleep and alcohol use. Participants indicated that alcohol affects sleep latency, sleep continuity, and sleep quality. Many participants discussed how alcohol helps them fall asleep faster. While some stated that alcohol helped them sleep longer and better, others perceived that their sleep is disrupted following alcohol consumption. Several factors may account for the differences in participants' perceptions of alcohol and sleep interactions. Participants with longer drinking histories may have become tolerant to alcohol's sedating effects and thus more likely to experience sleep disruptions from drinking. Tolerance to alcohol's sedating effects occurs quickly (Ebrahim et al., 2013); alcohol consumed close to bedtime increases sleep onset latency and decreases total sleep time with chronic, heavy use (Brower, 2003). In addition, the amount of alcohol consumed is important for determining when the negative effects of alcohol on sleep occur. Alcohol is metabolized at a constant rate that decreases breath alcohol concentrations (BAC) by approximately .01 - .02 per hour (Roehrs & Roth, 2001). At this rate, participants who go to sleep with a BAC level of .08 would have metabolized all of the alcohol 4-5 hours after going to sleep (Roehrs & Roth, 2001), and may report waking up after drinking at a much earlier time than preferred. In contrast, participants who go to sleep with higher BAC levels would still be metabolizing alcohol upon waking and may be able to sleep until their preferred wake time. Therefore, these individuals may not perceive that alcohol has the same negative effects on sleep. It is also possible that some students may delay bedtime on drinking nights and consequently experience greater homeostatic sleep pressure on those nights (Borbely, 1982). These students may then misattribute the effect of greater sleep pressure to alcohol. Our study design did permit an examination of these potential explanations. Future studies are needed to clarify the mechanisms underpinning college students' perceptions of alcohol and sleep interactions.

Reactions to the integrated intervention were positive overall. Most participants expressed enthusiasm for the integrated intervention. Their overall commitment to the program, however, varied depending on the content and structure of the intervention. Most wanted the content to be personalized to their unique health profile. Further, they preferred sleep-related content and information about sleep/alcohol interactions to general alcohol content. Participants also preferred an intervention that was easy to navigate by choice order, added new content daily and offered a way to monitor progress and the option for support from peers or a clinician. Participants indicated that they would be much more interested and committed to the intervention if it included this preferred content and structure. These findings are consistent with prior college student health research that suggests both the content and format of internet-based health interventions may need to employ innovative strategies to engage this cohort (Kwan, Faulkner, & Bray, 2013). Moreover, models of internet-based intervention development emphasize the need to involve targeted users to ensure interventions are relevant, easy to use, and meet users' needs (Skinner, Maley, & Norman, 2006).

Potential study limitations should be noted. We studied a small sample of college students in New England whose sleep disturbance, perceptions of sleep/alcohol interactions, and integrated intervention preferences may not be representative of all heavy drinking college students in the United States. The design does not enable us to quantify themes, make predictions about college students' behavior relevant to the proposed intervention, or determine the relative importance of themes by college students' clinical characteristics. We chose a primarily qualitative study design in order to describe college students' experiences and identify key themes that characterize their reactions to the proposed intervention. The quantitative findings should be interpreted with caution given the small sample size.

An integrated intervention that includes sleep and alcohol content may engage heavy drinking college students and warrants further investigation. Given that most heavy drinking college students do not seek alcohol treatment (Black & Coster, 1996), novel intervention strategies to engage this population are needed. Sleep may serve as an important “gateway” topic for intervening on heavy alcohol use among these high-risk college students. Moreover, improving sleep in this highly sleep disturbed group would have additional benefits on overall functioning and mental health/injury risk outcomes.

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Table 1
Focus Group Interview Excerpts

Domain	Sample Question
Perceptions of sleep difficulties, sleep-related consequences, and sleep-related barriers in college	“What are the barriers for you to get enough sleep in college?”
Perceptions of the connection between sleep and alcohol use	“What connection, if any, do you believe there is between alcohol use and sleep disturbance among college students?”
Reactions to a proposed integrated, internet-based sleep and alcohol intervention	“We are interested in developing an integrated web-based program to help college students improve their sleep and reduce negative drinking experiences. Would you be interested in this program? Would you use the program if it was available to you?”

Table 2
Participant clinical characteristics (N = 24)

SLEEP		Range
Pittsburgh Sleep Quality Index ^a , <i>M</i> (SD)		
Sleep duration in hours	6.65 (0.98)	5.00-8.00
Sleep latency in minutes	38.70 (18.95)	15.00-270.00
Total sleep disturbance	9.21 (3.16)	4.00-17.00
PROMIS – Sleep Related Impairment ^b , <i>M</i> (SD)	61.03 (7.19)	48.90-75.00
Cleveland Adolescent Sleepiness Questionnaire ^c , <i>M</i> (SD)	40.58 (8.15)	27.00-58.00
Chronotype (CSOM), <i>n</i> (%)		
Evening	2 (8)	
Intermediate	22 (92)	
Morning	0 (0)	
ALCOHOL		Range
Daily Drink Questionnaire (DDQ), <i>M</i> (SD)		
Typical drinks per week	24.50 (16.25)	3.00-65.00
Typical number of drinking days per week	4.04 (1.49)	2.00-7.00
Total binge days per week	2.79 (1.72)	0-7.00
Alcohol-related consequences (BYAACQ), <i>M</i> (SD) ^d	11.70 (4.67)	4.00-23.00
Ever drink to help with sleep, <i>n</i> (%)	8 (33)	
MENTAL HEALTH/INJURY RISK		Range
PROMIS - Anxiety ^b , <i>M</i> (SD)	59.19 (8.69)	36.30-75.80
PROMIS - Depression ^b , <i>M</i> (SD)	53.46 (9.65)	41.00-73.30
Driving after drinking, <i>n</i> (%)	7 (29)	
Rode with drunk driver, <i>n</i> (%)	13 (54)	

Note.

^a Pittsburgh Sleep Quality Index – clinical cutoff for “poor” sleepers is based on a total sleep disturbance score of 5 or 7;

^b PROMIS raw scores are converted to T score based on standardization sample, a score of 50 represents U.S. general population;

^c Cleveland Adolescent Sleepiness Questionnaire - higher scores indicate more sleepiness for a total possible score of 80;

^d Brief Young Adult Alcohol Consequences Questionnaire – 1 point assigned for each consequence for a total possible score of 24.