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A "Sleep 101" Program for College Students Improves Sleep Hygiene Knowledge and Reduces Maladaptive Beliefs about Sleep

Jacqueline D. Kloss, Christina O. Nash, Colleen M. Walsh, Elizabeth Culnan, and Sarah Horsey
Drexel University

Kathy Sexton-Radek
Elmhurst College and Suburban Pulmonary and Sleep Associates

Sensitizing young adults about sleep hygiene knowledge and helpful sleep attitudes may have the potential to instill long-lasting healthy sleep practices. Towards these ends, evaluation of psychoeducational program "Sleep 101" tailored to college students was undertaken. Following two weeks of sleep-log recordings, participants were randomly assigned to a Sleep 101 (experimental) condition or a sleep monitoring (control) condition. The Sleep 101 condition was comprised of two 90-minute workshops aimed to educate students about healthy sleep practices, helpful thoughts about sleep, and ways to improve sleep. The sleep monitoring group received a sleep hygiene handout and completed sleep logs for the study duration. Sleep 101 participants endorsed fewer maladaptive beliefs and attitudes about sleep, increased sleep hygiene knowledge, and reduced sleep onset latency compared to the sleep monitoring participants. Brief psychoeducational courses may be a cost-effective way to alleviate current, and/or prevent future, sleep problems in young adults.

Keywords: college students, dysfunctional beliefs and attitudes about sleep, sleep hygiene, sleep psychoeducation

INTRODUCTION

Poor sleep quality, shortened sleep duration, and emergent sleep disorders are ubiquitous among college students. Lund and colleagues[1] determined that nearly 60% of college students complain of poor sleep quality with frequent reliance on alcohol as well as over-the-counter and prescription medications to alter sleep–wake patterns. Students' average total sleep time is estimated at 7 hours,[1] which is well below the 8 hours recommended for young adults[2] and the 9 hours recommended for adolescents.[3] Furthermore, nearly 70% of college students report sleep problems, a drastic increase relative to the 26.7% documented in 1982.[4] Sleep disorders such as inadequate sleep hygiene, delayed sleep phase disorder, and insomnia disorder also manifest during this time.[5,6] Taken together, college students are particularly vulnerable to sleep deprivation and its adverse sequelae.

Competing demands of academic and social pressures, coupled with newfound autonomy and erratic schedules, can pose a challenge for college students to obtain adequate sleep.[7] As a result, sleep is often sacrificed with great cost to emotional well-being, physical health, and cognitive functioning (eg, attention, concentration, and learning).[8–10] Students classified as poor sleepers indicate increased negative mood and higher levels of stress compared to good sleepers.[1] Adolescents and college students with poor sleep are also at a higher risk for depression,[11] suicidal ideation,[10,12] and physical aggression.[10] College students with chronic insomnia similarly report higher rates of depression, fatigue, stress, anxiety, and lower quality of life; they are also more likely to utilize stimulants to cope with their

Correspondence should be addressed to Jacqueline D Kloss, Ph.D., Department of Psychology, Drexel University, 3141 Chestnut Street, Philadelphia, PA 19104, USA. E-mail: jdk29@drexel.edu

sleeping difficulties than are their healthier sleeping counterparts.[13] Beyond elevated use of caffeine and energy drinks,[1] the risks of sleep deprivation and poor sleep quality extend to other compromising health practices, such as greater use of marijuana, smoking, and alcohol use/abuse.[10,14,15] Health consequences of sleep deprivation can be even more severe and place students at risk for motor vehicle accidents,[16] comparable to that of driving while under the influence of alcohol.

The consequences of sleep deprivation on cognitive performance are germane to college students. Attention, learning, and memory consolidation are inherent to academic performance and success. Cognitive performance is clearly compromised in response to sleep deprivation in college students.[17–19] Specifically, sleep loss is associated with impairments in procedural and declarative learning, attention, memory consolidation, problem solving, and critical thinking among college students.[9] Under experimental sleep restriction, college students performed more poorly on critical thinking (ie, making inferences and deductions; recognizing assumptions) and also had a reduced awareness of their impairment.[17] These difficulties may translate into poor achievement. For example, students who reported pulling an "all-nighter" had lower academic achievement as measured by grade-point average (GPA).[20] GPAs also suffer among college students who are at risk for sleep disorders,[21] have later wake and rise times,[22,23] and shorter sleep duration.[24] Of particular relevance, Curcio et al[9] observed that under conditions of optimal sleep (as opposed to compromised sleep), neurocognitive performance deficits improved. This reversibility points to the need to instill healthy college student sleep practices.

Despite pervasive sleep deprivation of college students, data on the contributors, patterns, and consequences specific to the transition from adolescence to young adulthood are just starting to emerge.[1,25] As noted above, decreased sleep quantity and quality, inadequate sleep hygiene, and poor sleep habits (eg, overuse of caffeine, extensive napping, insufficient sleep, erratic sleep scheduling), circadian dysrhythmia, and insomnia are among the primary contributors of sleep disruption in this population.[25,26] Thus, college students are an ideal population to educate about the health hazards of sleep deprivation, not simply as an analog, but as a target population in their own right. The college setting is conducive to infusing sleep hygiene knowledge (ie, knowledge about healthy sleep practices, such as the effects of caffeine, alcohol, and timing of exercise, napping, etc.), dismissing myths, and correcting assumptions about sleep and sleep need. Raising awareness about the cognitive and behavioral correlates of sleep and teaching empirically based strategies to overcome sleep problems has the potential to decrease, or even prevent, the adverse effects of sleep deprivation during this critical developmental transition.

Several studies have conducted variations of sleep education programs and interventions tailored to college students.[27–31] Brown and colleagues'[27] one meeting Sleep Treatment and Education Program (STEPS) demonstrated improvements after 6 weeks in sleep hygiene practices and sleep quality among college students, compared to a control group. Their program was comprised of a 30-minute educational presentation delivered in an introductory psychology course and focused on sleep hygiene education procedures. Tsai and Li[29] followed students who enrolled in their "sleep management" semester-long course, which covered a breadth of lectures on sleep and sleep-related topics. However, the distribution of time spent on sleep education was not noted. Compared to students who were not enrolled in the course, the researchers found marginal effects for sleep quality and nap time, and emphasized the need for greater attention to insufficient sleep and daytime sleepiness. Quan and colleagues [30] found that an Internet supplement on sleep (delivered to undergraduates as part of their Introduction to Psychology course) resulted in small increases in sleep knowledge, more consistent wake times, and active attempts to increase their total sleep times relative to those in the control group. Trockel and colleagues[28] found that an 8-session, email-delivered, cognitive-behavioral program yielded decreases in depressive symptoms and enhanced sleep quality among poor sleepers. More recently, Taylor et al[31] demonstrated the efficacy of a 6-session CBTi (cognitive behavioral therapy for insomnia) intervention delivered to college students with insomnia compared to a waitlist control.

Taken together, these studies have primarily focused on educational and behavioral strategies to improve sleep. Only two of the aforementioned studies[28,31] included cognitive interventions as part of their program for college students. One study,[28] however, did not specifically measure change in thoughts about sleep in response to the intervention; the other study[31] involved modifying beliefs about sleep as part of a standard CBTi package geared toward students with an insomnia diagnosis. Thus, the role of maladaptive beliefs and attitudes about sleep among a general college student population has been neglected.

Maladaptive beliefs and attitudes about sleep (often measured by the Dysfunctional Beliefs and Attitudes about Sleep scale; DBAS-10)[32] refer to the faulty beliefs and appraisals, unrealistic expectations, and perceptual and attention bias in reference to sleeplessness and its daytime consequences.[33] Based on extant literature, maladaptive beliefs and attitudes about sleep have been shown to be associated with cognitive arousal and insomnia symptoms in older adults.[34] College students with insomnia similarly endorse higher ratings of such unhelpful beliefs and attitudes about sleep compared to students without insomnia.[35] Worries about sleep and

holding maladaptive beliefs and attitudes about sleep are known to contribute to and perpetuate sleep onset latencies.[36,37] Even in university students who are characterized as "good sleepers," endorsements of maladaptive beliefs and attitudes about sleep are associated with stress-related transient sleep disturbances.[38] In turn, improvement in maladaptive attitudes about sleep has been shown to correlate with reductions in sleep disturbance.[32,39–41] Given that difficulty falling asleep is one of the primary complaints of college students,[5] brief educational strategies to correct or decrease the such unhelpful beliefs and attitudes about sleep could be vital to healthy sleep.

The current study was undertaken, therefore, to expand on existing literature by testing the efficacy of a brief psychoeducational intervention, Sleep 101, with a focus on targeting maladaptive beliefs and attitudes about sleep and educating students about the importance of healthy sleep practices (sleep hygiene knowledge), optimal sleep timing, scheduling, and duration, and helpful beliefs and attitudes about sleep and sleep disturbances. Compared to a control group (sleep-monitoring group; SM), we hypothesized that individuals assigned to the Sleep 101 education group (SE) would report increased sleep hygiene knowledge and endorse fewer maladaptive beliefs and attitudes toward sleep. Our primary focus was twofold: (1) enhance knowledge about sleep hygiene, and (2) reduce maladaptive beliefs and attitudes about sleep. Our secondary focus was to measure the preliminary effects of the psychoeducational program on reducing sleep onset latency.

METHODS

Participants

One hundred and twenty undergraduates from a mid-size university in the northeastern United States participated in the study. Their ages ranged from 18–28 years with a mean age of 21.11 (SD = 2.43) years; 73 participants (60.8%) were women. Of participants, 72 (60%) identified as Caucasian, 21 (17.5%) as Asian American, 10 (8.3%) as African American, 1 Pacific Islander, 2 (1.7%) as Hispanic, and 14 (11.7%) as "other." Of participants, 24 (20.0%) reported being in their first academic year, 27 (22.5%) were in their second, 22 (18.3%) were in their third, 19 (15.8%) were in their fourth academic year, 11 (9.2%) were in their fifth academic year, and 17 (14.2%) did not specify. These demographics are representative of the university's undergraduate population. Participants completed the study during the third through sixth weeks of a typical 11-week academic quarter.

Measures

Demographic Questionnaire

Participants completed a demographic questionnaire to assess age, race/ethnicity, work status, year in school, week of the school term enrolled in the study, current number of college credits enrolled and average bed and wake times for both weekdays and weekends.

Dysfunctional Beliefs about Sleep Questionnaire Short Form (DBAS-SF)

The DBAS-SF is used to assess maladaptive beliefs and thoughts regarding sleep.[32] This 10-item scale asks participants to rate their beliefs about sleep between strongly disagree and strongly agree. Individuals rated their responses on a 100-mm visual analogue scale with 0, strongly disagree; to 100, strongly agree. This measure has been found to be reliable and valid; the shortened 10-item version has a high correlation with the original DBAS ($r = .81$) and has acceptable internal consistency.[42,43] Cronbach's alpha was .65 in our sample.

Pittsburgh Sleep Quality Index (PSQI)

The PSQI was employed to assess participants' subjective sleep quality.[44] This 19-item questionnaire produces the seven composite scores of subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication and daytime dysfunction. These composite scores are then summed to create a global score, with scores greater than 5 indicative of poor sleep quality.[44] The PSQI is a well-established reliable and valid measure of sleep quality ($\alpha = .85$).[45] In our sample, Cronbach's alpha was 0.69.

Sleep Hygiene Awareness and Practice Scale (SHAPS)

The SHAPS is a self-report questionnaire, used to assess knowledge and practice of sleep hygiene. It is comprised of three subscales: Sleep Hygiene Knowledge (SHK), Caffeine Knowledge (CK) and Sleep Hygiene Practice (SHP).[46] The SHK scale uses 13 questions to assess participants' knowledge about the different behaviors that affect sleep using a Likert scale of 1–7, with 1–3, beneficial to sleep; 4, no effect on sleep; and 5–7, disruptive to sleep. For example, participants rate the degree to which *Waking up at the same time each day* is beneficial or disruptive to sleep. The CK subscale consists of 18 items, which measure participants' familiarity with whether or not an item is caffeinated. The SHP subscale is comprised of 19 items where participants rate the frequency (nights per week) that they engage in activities known to affect sleep (eg, *How many days per week do you take naps*). Among college students, acceptable reliability levels have been found for the SHK

and SHP subscales, but not for the CK subscale.[14] In our sample, the SHK yielded a Cronbach's alpha of .52, while the CK and SHP yielded Cronbach's alphas = .41 and .42 respectively. The latter two were not used in our analyses. While the internal consistency of the SHK subscale was not optimal, it may reflect that "knowledge" may not be a unitary construct, thus a low reliability may be expected.

Insomnia Severity Scale (ISI)

Participants completed the ISI, a 7-item questionnaire, in order to subjectively assess insomnia severity.[47] This 7-item measure employs a Likert-scale format asking participants to rate items concerning their insomnia severity with 0, never; 1, mild; 2, moderate; 3, severe; or 4, very severe; with scores totals of 8 or higher being indicative of mild insomnia symptoms. The scale has well established reliability ($\alpha = .74$) and validity.[47] In our sample, Cronbach's alpha was .84.

Sleep Log

For preliminary analysis, all participants completed a daily sleep log for the duration of the study. Standardized sleep logs were used for the purpose of our study.[37] Participants were sent home with explicit instructions about how and when to complete the sleep logs. Specifically, participants were reminded to complete the pencil-and-paper sleep logs each day upon waking for the entirety of the study. We were primarily interested in ascertaining sleep onset latency. Sleep onset latency was determined daily by the difference between the time the participant reported going to bed and the time it was estimated that the participant fell asleep. Averages on sleep onset latency were then calculated for each week.

Procedures

Upon Institutional Review Board (IRB) approval, participants were recruited from Psychology classes, including both psychology majors and non-majors. After informed consent was received from each participant, participants completed a series of baseline measures (Demographic form, DBAS-SF, ISI, PSQI, and SHAPS). Immediately following, each participant was randomized into either the SM group or the SE group. Both the SE and SM group were given a brief handout on general sleep hygiene practices (eg, avoid caffeine) and completed two weeks of baseline sleep logs. At the end of the two-week baseline period, participants in the SE condition returned for two, 90-minute Sleep 101 workshops, which were on average one week apart. In contrast, participants in the SM condition continued to monitor their sleep onset latency, concurrent with the SE condition during that two week period. Both groups completed follow-up measures (ISI, DBAS-SF, PSQI, SHAPS) at the end of those two weeks. Thus, all participants were enrolled in the study for four consecutive weeks, and completed the sleep log for the entirety of the study.

Sleep 101 Workshop Condition

During the first 90-minute workshop, SE participants were given a presentation modeling the *National Sleep Foundation* (2003) Sleep Basics materials on sleep stages, benefits of getting enough sleep, daytime consequences of poor sleep, general sleep disorders (eg, insomnia, obstructive sleep apnea, restless legs syndrome), information on where to seek help for sleep difficulties and tips for good sleep hygiene practices. They were then given another week of sleep logs to continue to monitor their sleep onset latency and asked to return the following week. During the second 90-minute workshop, cognitive strategies (ie, coping with maladaptive beliefs and thoughts about sleep) and behavioral strategies (ie, relaxation, stimulus control, sleep restriction) were discussed. The cognitive focus of the workshop was designed to help participants to understand the role of thoughts influencing sleep, identify common cognitive errors associated with difficulties sleeping through case vignettes and handouts, form alternative cognitions for these maladaptive thoughts, and practice relapse prevention. For example, participants were presented with the maladaptive thought, *When I have trouble sleeping, I should just stay in bed and try harder*. Participants were instructed to identify cognitive errors that included making faulty assumptions in response. Maladaptive behaviors that may follow as a consequence of that thought were then discussed (ie, *Staying in bed when unable to sleep may lead to a negative association between bed and sleep*). Next, alternative thoughts were described, including the suggestion, *It is best to spend less time in bed when not sleeping and sleep more efficiently.* Finally, tips were presented on how to cope with a "bad" night of sleep and how to prevent relapse. The components included in the Sleep 101 program parallel those used by other sleep education and CBTi programs that have been found to be efficacious and helpful for their use with adults in general, and in some instances, college students, in specific.[27,48–50] All workshops were conducted by doctoral level students who have been trained and supervised in cognitive and behavioral therapy for insomnia, including sleep hygiene, stimulus control, sleep restriction and cognitive therapy.

Analytical Strategy

First, descriptive statistics of our primary variables of interest were calculated to describe the study sample. Second, independent samples *t* tests and chi-square tests of independence were conducted to ensure that groups (SM vs SE) did not significantly differ at baseline. Third, correlations were utilized to describe the associations between our primary

variables of interest. Next, given attrition during the study, independent samples *t* tests and chi-square tests of independence were employed to compare study completers with those who dropped out (non-completers) on demographic variables and the primary variables of interest. For our primary analysis, three 2 ´ 2 repeated-measures ANOVAs were utilized to examine the interactions of group (SM and SE) and time on the endorsement of DBAS-SF, sleep hygiene knowledge, and sleep onset latency, respectively. Given the plan for primary analysis, an a-priori power analysis, with an alpha level of .05, a medium effect size, and power of .80 yielded that 128 (64 per group) participants would be needed to detect an effect if one existed.

RESULTS

Preliminary Analyses

Descriptive statistics and the primary variables of interest were found to be normally distributed and a summary of means, standard deviations, and/or frequencies of these variables are presented in Tables 1 and 2, respectively. Groups did not differ at baseline on any demographic variables (gender, ethnicity, year in school, and week in the term when participant joined the study), or the primary variables of interest (ie, SHAPS, DBAS-SF, ISI, PSQI), all *p*'s > .05. Additionally, groups did not differ on any subjective reports of sleep onset latency.

TABLE 1
Frequency Distributions of Demographic Characteristics ($N = 120$)

		Group	
Variable	Total Sample	Education (1)	Monitoring (2)
Sex			
Male	46 (38.3%)	23 (36.5%)	1 23 (40.4%)
Female	73 (60.8%)	39 (61.9%)	34 (59.6%)
Not specified	1 (0.8%)	1 (1.6%)	
Ethnicity			
Caucasian	72 (60.0%)	34 (54.0%)	38 (66.7%)
African American	10 (8.3%)	6 (9.5%)	4 (7.0%)
Hispanic	2 (1.7%)	2 (3.2%)	0 (0.0%)
Asian American	21 (17.5%)	11 (17.5%)	10 (17.5%)
Pacific Islander	1 (0.8%)	1 (1.6%)	0 (0.0%)
Other	14 (11.7%)	9(14.3%)	5 (8.8%)
Current term			
Fall 09–10	0 (0.0%)	0 (0.0%)	0 (0.0%)
Winter 09–10	73 (60.8%)	39 (61.9%)	34 (59.6%)
Spring 09–10	21 (17.5%)	11 (17.5%)	10 (17.5%)
Fall 10–11	25 (20.8%)	13 (20.6%)	12 (21.1%)
Week of term			
Week 3	47 (39.2%)	25 (39.7%)	22 (38.6%)
Week 4	33 (27.5%)	18 (28.6%)	15 (26.3%)
Week 5	28 (23.3%)	15 (23.8%)	13 (22.8%)
Week 6	11 (9.2%)	5 (7.9%)	6 (10.5%)
Year in school			
1	24 (20.0%)	12 (19.0%)	12 (21.1%)
2	27 (22.5%)	15 (23.8%)	12 (21.1%)
3	22 (18.3%)	14 (22.2%)	8 (14.0%)
4	19 (15.8%)	8 (12.7%)	11 (19.3%)
5	11 (9.2)%	6 (9.5%)	5 (8.8%)
Not specified	17 (14.2%)	8 (12.7%)	9 (15.8%)

At baseline, participants demonstrated sleep difficulties as indicated by an average PSQI score of 6.6 (SD = 3.58), ISI score of 9.23 (SD = 5.82) and SOL average of 25.19 (SD = 27.75) minutes. Of note, SOL was on average, shorter on weekends (mean = 21.81; SD = 23.01) vs. weekdays (mean = 27.24; SD = 30.42). The average sleep length (extracted from the PSQI) was 7.04 (SD = 1.51) at baseline. While participants endorsed average sleep hygiene knowledge (mean = 20.38, SD = 4.34) as measured by the SHK, DBAS-SF scores suggest that they held moderate maladaptive beliefs and attitudes about their sleep (mean = 51.59, SD = 13.92).

The Relationship between Primary Variables of Interest

Bivariate relationships between our primary variables of interest at baseline are presented in Table 3. Total DBAS-SF scores were positively correlated with total ISI ($r = .382$, $p < .01$), PSQI ($r = .317$, $p < .01$) scores, and negatively correlated with SHK scores ($r = –.379$, $p < .01$). As expected, these scores reflect that greater maladaptive beliefs about sleep were related to greater insomnia severity, poorer sleep quality, and less sleep hygiene knowledge. Total ISI scores were positively correlated with PSQI ($r = .739$, $p < .01$).

Completers versus Non-completers

Participants who did not complete the follow-up ($N = 20$) were compared to participants who completed both the baseline and follow-up ($N = 100$) measures. No significant differences emerged between completers and non-completers on our demographic and primary variables of interest, all *p*'s > .05. However, attrition did differ by group. There was greater attrition in the SE group when compared to the SM group, χ^2 (1, $N = 120$) = 4.87, $p = .03$. Our planned analyses followed an intent-to-treat model.

Test of Hypotheses

Dysfunctional Attitudes and Beliefs about Sleep-SF

A repeated-measures ANOVA was used to examine group differences on DBAS-SF scores following psychoeducational workshops (pre- to post-educational workshop). As hypothesized, there was a significant interaction between condition and time, Wilks' Lambda = .92, $F(1, 90) = 7.99$, $p = .006$, $d = .58$, revealing that participants in the SE group showed significantly improved DBAS-SF scores (mean = 42.24, SD = 17.95) when compared with

TABLE 2
Total Score Descriptives and Group Parity at Baseline

	Baseline Mean (SD)				Post Mean (SD)			
Measure	Total $N = 120$	Education $n = 63$	Monitoring $n = 57$	p	Total $N = 120$	Education $n = 63$	Monitoring $n = 57$	p
DBAS-SF	51.59 (13.92)	50.76 (14.53)	52.51 (13.29)	.51	48.41 (17.24)	42.24 (17.95)	53.63 (14.87)	.001*
ISI	9.23 (5.82)	8.87 (6.07)	9.61 (5.57)	.49	8.42 (5.51)	7.47 (5.86)	9.25 (5.11)	.11
PSQI	6.60 (3.58)	6.29 (3.43)	6.98 (3.76)	.35	5.77 (2.88)	5.49 (3.28)	6.04 (2.44)	.36
SHAPS–SHK	20.38 (4.34)	20.06 (3.61)	20.74 (5.04)	.41	18.40 (4.03)	16.66 (3.33)	19.98 (3.97)	.001*

*$p = .001$

the SM group (mean = 53.63, SD = 14.87) at follow-up (see Table 4).

Sleep Hygiene Knowledge

A repeated-measures analysis of variance (ANOVA) was conducted to assess the effect of a sleep education program versus a sleep monitoring condition on participants' sleep hygiene knowledge (SHK) from baseline to follow-up. As hypothesized, there was a significant interaction between condition and time, Wilks' Lambda = .95, $F(1, 97) = 5.12$, $p = .026$, $d = .46$ demonstrating that participants in the SE group had significantly better sleep hygiene knowledge scores (mean = 16.66, SD = 3.33) after the sleep education program when compared with those in the SM group (mean = 19.98, SD = 3.97) at follow-up (see Table 4).

Sleep Onset Latency (SOL)

Exploratory analyses were conducted to examine whether the psychoeducation may have reduced subjectively reported SOL in the sleep education group relative to the monitoring group. There was a significant interaction between condition and time, Wilks' Lambda = .93, $F(1, 91) = 6.88$, $p = .01$, $d = .54$, demonstrating that participants in the SE group displayed significantly decreased SOL (mean = 20.94, SD = 14.58) when compared with participants in the SM group (mean = 27.42, SD = 38.99) at follow-up (see Table 4). This pattern remained consistent for both weekdays versus weeknights. On weekdays, SOL decreased in the SE group (mean = 28.98; SD = 22.38 [pre] to mean = 21.60; SD = 17.14 [post]) compared to the SM group, whose SOL slightly increased (mean = 26.58; SD = 37.56 [pre] to mean = 29.28; SD 43.87 [post]), Wilkes Lamda = .92, $F(1, 90) = 7.62$, $p = .01$. Similarly, SOL decreased on weekends in the SE group (mean = 24.03; SD 21.33 [pre] to mean = 16.93; SD = 12.71 [post], compared to the SM group whose SOL slightly increased (mean = 20.07; SD = 25.19 [pre] to mean = 21.30, SD = 31.45 [post], Wilks Lamda = .94, $F(1, 92) = 6.00$, $p = .02$.

TABLE 3
Pearson Correlations

Measures	1	2	3	4
1. DBAS-SF	—	.382*	.317*	–.379*
2. ISI	—	—	.739*	–.046
3. PSQI	—	—	—	.111
4. SKH	—	—	—	—

*$p < .01$.

Post Hoc Analysis

While it was not expected that the brief intervention would show immediate effects over the course of the study due to the brief time frame, exploratory analyses were conducted on the PSQI and sleep duration variable (extracted from the PSQI). Sleep quality scores improved over time, [mean = 6.40, SD = 3.18 to mean = 5.85, SD = 2.99, Wilks' lambda = .93, $F(1, 71) = 5.79$, $p = .02$, $d = .57$, but the interaction effect was not significant, Wilks' lambda = 1.00, $F(1, 71) = .08$, $p = .79$, $d = .06$. That is, sleep quality did not change differentially by SE versus SM. Sleep duration (as extracted from the PSQI) did not change over time (mean = 7.00, SD = 1.41 to mean = 7.03, SD = 1.20).

DISCUSSION

Our findings support that a brief sleep intervention conferred benefits to college students compared to a sleep-monitoring condition alone. Namely, participants in our

TABLE 4
Analyses of Variance

Measure		*df*	*F*	*p*	Cohen's *d*
DBAS-SF					
	Time	(1, 90)	2.84	.10	.36
	Time × Condition	(1, 90)	7.99	.01	.58
SHK					
	Time	(1, 97)	24.09	.00	1.00
	Time × Condition	(1, 97)	5.12	.02	.46
SOL					
	Time	(1, 91)	1.12	.29	.20
	Time × Condition	(1, 91)	6.88	.01	.54

Sleep 101 program, indicated greater sleep hygiene knowledge, endorsed fewer maladaptive beliefs and attitudes about sleep, and reduced SOL following the workshops, relative to the control group.

Extant literature shows that unhelpful beliefs and attitudes about sleep play an integral role in the perpetuation of sleep difficulties[37,40,51,52] and correcting maladaptive beliefs and attitudes about sleep can promote better sleep over time.[40,41] These unhelpful thoughts are theorized to lead to increases in pre–sleep arousal that may inhibit normal sleep onset processes or result in sleep fragmentation (when associated with nighttime awakenings). This theory is a fundamental component of cognitive and behavioral therapy for insomnia (CBT-I), a widely used and effective treatment for insomnia in a multitude of populations.[53] Given the powerful influence of these factors on sleep, it remains critical to target them, even in brief interventions. While most studies have shown that maladaptive cognitions about sleep can be reduced over the typical 6 to 8 sessions recommended for CBT-I,[54] our study supported and extended on these previous findings by showing maladaptive cognitions may be altered in as little as one 90-minute workshop. While cognitive strategies have been used most widely in populations with insomnia, college students still remain a group that may derive benefit from them. A brief intervention such as ours may serve as a preventative strategy for college students who engage in unhelpful thoughts about their sleep. Future studies ought to replicate the finding that changes in unhelpful beliefs and attitudes about sleep lead to changes in sleep outcomes, particularly in college students. In addition, improving sleep hygiene knowledge and increasing cognitive coping strategies may have the potential to increase perceived behavioral control. Knowlden, Sharma, and Bernard[55] demonstrated that perceived behavioral control was the strongest predictor for obtaining adequate total sleep. Brief interventions such as ours that improve knowledge about sleep-related behavioral control and cognitive strategies could potentially increase perceived behavioral control in a college student population.

Consistent with previous findings of brief interventions for sleep in college students,[27–29] participants in our SE group increased their sleep hygiene knowledge following our 2-workshop intervention relative to our SM group. Our findings also indicate that sleep hygiene knowledge may be lacking in the college population and brief interventions may be sufficient to provide needed education about good sleep practices. However, as noted by Brown and colleagues,[14] good sleep hygiene knowledge was weakly associated with good sleep hygiene practices and not directly related to overall sleep quality, whereas good sleep practices were strongly associated with overall sleep quality.[14] While sleep hygiene knowledge itself is an important component of strategies aimed at improving sleep, simply increasing sleep hygiene knowledge or correcting maladaptive beliefs about sleep may not necessarily result in changes to sleep behaviors. Future studies on interventions aimed at translating student sleep hygiene knowledge and attitudes into behavior change that serve to reduce sleep disturbances and improve sleep quality are clearly needed.

Even within the short time frame of the study, SOL times decreased in the Sleep 101 group relative to the SM group, following the second workshop. While encouraging for an exploratory analysis, this finding is of limited clinical significance (6 minutes difference). This said, these results suggest that even a brief intervention, such as Sleep 101, indicate early changes to subjectively reported sleep parameters. Longer follow-ups (over the course of weeks or months), particularly among students with sleep initiation difficulties in the clinical range (>30 minutes), would enable better validation for this finding. It is also possible that the short time frame may have been too premature to observe changes in sleep quality and duration. Longer follow-ups are recommended to assess whether Sleep 101 is associated with changes in sleep quality and duration.

Limitations

Due to the constraints of the "quarter system" (10-week terms) at the University, obtaining follow-up data beyond the period of the study proved difficult in following these participants' retention and practice in their sleep hygiene knowledge, adaptive thinking about their sleep and potential changes to sleep disturbances (eg, improvements in SOL). For example, it is possible that, over time, SOL would continue to decrease should the participants have had more opportunity to practice the strategies that they learned. Our sleep measures relied on self-report. While the low reliability may raise caution to the interpretability of the sleep hygiene knowledge ratings, the availability of standardized measures for sleep hygiene knowledge was limited. Future studies should aim to establish sleep hygiene knowledge tests with well-established psychometric properties. Future studies should aim to carefully assess sleep continuity over time and include objective measures, such as wrist actigraphy. An optimal control group should also meet for comparable session times to ensure that both groups were treated as equal as possible. While we sought to focus our intervention on factors that we believed were impacting college students' sleep as a group, such as poor sleep hygiene practices, maladaptive beliefs and attitudes about sleep and behavioral approaches for reducing insomnia symptoms (ie, sleep restriction and stimulus control), our intervention was not tailored to individual sleep problems. Future studies ought to identify individual sleep challenges, such as insomnia or circadian delays, and tailor interventions based on individual sleep needs.

CONCLUSIONS

In summary, our findings are encouraging and support the use of brief interventions to help college students reduce maladaptive thoughts about their sleep, increase their sleep hygiene knowledge and potentially improve difficulty with falling asleep. Furthermore, a sleep education program for college students may be a cost-effective and easily disseminated way to improve sleep and/or potentially serve as a prevention measure for college students. Given the negative health consequences and large economic burden that insomnia and other sleep disorders carry, preventing and targeting maladaptive cognitions about sleep at a young age may prove helpful on many levels.

REFERENCES

[1] Lund HG, Reider BD, Whiting AB, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health.* 2010;46(2):124–132.

[2] National Sleep Foundation. How much sleep do we really need? 2009. http://sleepfoundation.org/how-sleep-works/how-much-sleep-do-we-really-need.

[3] Carskadon MA, Acebo C. Regulation of sleepiness in adolescents: update, insights, and speculation. *Sleep.* 2002;25(6):606–616.

[4] Hicks RA, Fernandez C, Pellegrini RJ. Self-reported sleep durations of college students: normative data for 1978–79, 1988–89, and 2000–01. *Percept Motor Skills.* 2001;93(1):139–140.

[5] Jensen DR. Understanding sleep disorders in a college student population. *J College Couns.* 2003;6(1):25–34.

[6] Kang J-H, Chen S-C. Effects of an irregular bedtime schedule on sleep quality, daytime sleepiness, and fatigue among university students in Taiwan. *BMC Public Health.* 2009;9(1):248.

[7] Ligouri G, Schuna J, Mozumdar A. Semester long changes in sleep duration for college students. *College Student J.* 2011;45(3).

[8] Kloss JD, Nash CO, Horsey SE, Taylor DJ. The delivery of behavioral sleep medicine to college students. *J Adolesc Health.* 2011;48 (6):553–561.

[9] Curcio G, Ferrara M, De Gennaro L. Sleep loss, learning capacity and academic performance. *Sleep Med Rev.* 2006;10(5):323–337.

[10] Vail-Smith K, Felts WM, Becker C. Relationship between sleep quality and health risk behaviors in undergraduate college students. *College Student J.* 2009;43(3).

[11] Roane BM, Taylor DJ. Adolescent insomnia as a risk factor for early adult depression and substance abuse. *Sleep.* 2008;31(10):1351–1356.

[12] Choquet M, Kovess V, Poutignat N. Suicidal thoughts among adolescents: an intercultural approach. *Adolescence.* 1993.

[13] Taylor DJ, Bramoweth AD, Grieser EA, Tatum JI, Roane BM. Epidemiology of insomnia in college students: relationship with mental health, quality of life, and substance use difficulties. *Behav Ther.* 2013;44(3):339–348.

[14] Brown FC, Buboltz WC, Jr., Soper B. Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in university students. *Behav Med.* 2002;28(1):33–38.

[15] Sierra JC, Jiménez-Navarro C, Martín-Ortiz JD. Calidad del sueño en estudiantes universitarios: importancia de la higiene del sueño. *Salud Mental.* 2002;25(6):35–43.

[16] Taylor DJ, Bramoweth AD. Patterns and consequences of inadequate sleep in college students: substance use and motor vehicle accidents. *J Adolesc Health.* 2010;46(6):610–612.

[17] Pilcher JJ, Walters AS. How sleep deprivation affects psychological variables related to college students' cognitive performance. *J Am Coll Health.* 1997;46(3):121–126.

[18] Taylor DJ, McFatter RM. Cognitive performance after sleep deprivation: does personality make a difference? *Pers Individ Dif.* 2003;34 (7):1179–1193.

[19] Yang RH, Hu SJ, Wang Y, Zhang WB, Luo WJ, Chen JY. Paradoxical sleep deprivation impairs spatial learning and affects membrane excitability and mitochondrial protein in the hippocampus. *Brain Res.* 2008;1230:224–232.

[20] Thacher PV. University students and the "all nighter": correlates and patterns of students' engagement in a single night of total sleep deprivation. *Behav Sleep Med.* 2008;6(1):16–31.

[21] Gaultney JF. The prevalence of sleep disorders in college students: impact on academic performance. *J Am Coll Health.* 2010;59(2):91–97.

[22] Gray EK, Watson D. General and specific traits of personality and their relation to sleep and academic performance. *J Pers.* 2002;70 (2):177–206.

[23] Trockel MT, Barnes MD, Egget DL. Health-related variables and academic performance among first-year college students: implications for sleep and other behaviors. *J Am Coll Health.* 2000;49 (3):125–131.

[24] Kelly WE, Kelly KE, Clanton RC. The relationship between sleep length and grade-point average among college students. *College Student J.* 2001;35(1).

[25] Vela-Bueno A, Fernandez-Mendoza J, Olavarrieta-Bernardino S. Sleep patterns in the transition from adolescence to young adulthood. *Sleep Med Clin.* 2009;4(1):77–85.

[26] Onyper SV, Thacher PV, Gilbert JW, Gradess SG. Class start times, sleep, and academic performance in college: a path analysis. *Chronobiol Int.* 2012;29(3):318–335.

[27] Brown FC, Buboltz WC, Jr., Soper B. Development and evaluation of the Sleep Treatment and Education Program for Students (STEPS). *J Am Coll Health.* Jan-Feb 2006;54(4):231–237.

[28] Trockel M, Manber R, Chang V, Thurston A, Tailor CB. An e-mail delivered CBT for sleep-health program for college students: effects on sleep quality and depression symptoms. *JCSM.* 2011;7(3):276.

[29] Tsai LL, Li SP. Sleep education in college: a preliminary study. *Percept Motor Skills.* 2004;99(3 Pt 1):837–848.

[30] Quan SF, Anderson JL, Hodge GK. Use of a supplementary internet based education program improves sleep literacy in college psychology students. *JCSM.* 2013;9(2):155.

[31] Taylor D, Zimmerman M, Gardner C, et al. A pilot randomized controlled trial of the effects of cognitive-behavioral therapy for insomnia on sleep and daytime functioning in college students. *Behav Ther.* 2014.

[32] Edinger JD, Wohlgemuth WK. Psychometric comparisons of the standard and abbreviated DBAS-10 versions of the dysfunctional beliefs and attitudes about sleep questionnaire. *Sleep Med.* 2001;2 (6):493–500.

[33] Morin CM, Vallières A, Ivers H. Dysfunctional beliefs and attitudes about sleep (DBAS): validation of a brief version (DBAS-16). *Sleep.* 2007;30(11):1547.

[34] Morin CM, Stone J, Trinkle D, Mercer J, Remsberg S. Dysfunctional beliefs and attitudes about sleep among older adults with and without insomnia complaints. *Psychol Aging.* 1993;8(3):463.

[35] Means MK, Lichstein KL, Epperson MT, Johnson CT. Relaxation therapy for insomnia: nighttime and day time effects. *Behav Res Ther.* 2000;38(7):665–678.

[36] Wicklow A, Espie C. Intrusive thoughts and their relationship to actigraphic measurement of sleep: towards a cognitive model of insomnia. *Behav Res Ther.* 2000;38(7):679–693.

[37] Morin C, Barlow DH. *Insomnia: Psychological Assessment and Management*. New York, NY: Guilford Press; 1993.

[38] Yang C-M, Chou CP-W, Hsiao F-C. The association of dysfunctional beliefs about sleep with vulnerability to stress-related sleep disturbance in young adults. *Behav Sleep Med.* 2011;9(2):86–91.
[39] Carney CE, Edinger JD. Identifying critical beliefs about sleep in primary insomnia. *Sleep.* 2006;29(4):444–453.
[40] Morin C, Blais F, Savard J. Are changes in beliefs and attitudes about sleep related to sleep improvements in the treatment of insomnia? *Behav Res Ther.* 2002;40(7):741–752.
[41] Sato M, Yamadera W, Matsushima M, Itoh H, Nakayama K. Clinical efficacy of individual cognitive behavior therapy for psychophysiological insomnia in 20 outpatients. *Psychiatr Clin Neurosci.* 2010;64 (2):187–195.
[42] Edinger JD, Wohlgemuth WK, Radtke RA, Marsh GR, Quillian RE. Does cognitive-behavioral insomnia therapy alter dysfunctional beliefs about sleep? *Sleep.* 2001;24(5):591–599.
[43] Wright H, Lack L, Morin C, Edinger J. Dysfunctional beliefs and attitudes about sleep questionnaire: preliminary factor analysis. *Sleep.* 2000;23(Suppl 2):A381.
[44] Buysse DJ, Reynolds CF, 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatr Res.* 1989;28(2):193–213.
[45] Backhaus J, Junghanns K, Broocks A, Riemann D, Hohagen F. Test–retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. *J Psychosom Res.* 2002;53(3):737–740.
[46] Lacks P, Rotert M. Knowledge and practice of sleep hygiene techniques in insomniacs and good sleepers. *Behav Res Ther.* 1986;24 (3):365–368.
[47] Bastien CH, Vallières A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Med.* 2001;2(4):297–307.
[48] Morgenthaler T, Kramer M, Alessi C, et al. Practice parameters for the psychological and behavioral treatment of insomnia: an update. An American Academy of Sleep Medicine report. *Sleep.* 2006;29 (11):1415.
[49] Harvey AG, Sharpley AL, Ree MJ, Stinson K, Clark DM. An open trial of cognitive therapy for chronic insomnia. *Behav Res Ther.* 2007;45(10):2491–2501.
[50] Morin CM, Bootzin RR, Buysse DJ, Edinger JD, Espie CA, Lichstein KL. Psychological and behavioral treatment of insomnia: update of the recent evidence (1998–2004). *Sleep.* 2006;29(11):1398.
[51] Espie CA. Insomnia: conceptual issues in the development, persistence, and treatment of sleep disorder in adults. *Annu Rev Psychol.* 2002;53(1):215–243.
[52] Harvey AG. A cognitive theory and therapy for chronic insomnia. *J Cognitive Psychother.* 2005;19(1):41–59.
[53] Perlis ML, Smith MT, Benson-Jungquist C, Posner DA. *Cognitive Behavioral Treatment of Insomnia. A Session-by-Session Guide.* New York, NY: Springer; 2005.
[54] Edinger JD, Means MK. Cognitive-behavioral therapy for primary insomnia. *Clin Psychol Rev.* Jul 2005;25(5):539–558.
[55] Knowlden AP, Sharma M, Bernard AL. A Theory of Planned Behavior research model for predicting the sleep intentions and behaviors of undergraduate college students. *J Prim Prev.* Feb 2012;33(1):19–31.

Appendix

Appendix A. Sleep 101 Workshop 1 Outline

- Basic facts about sleep and changes in sleep patterns over the lifespan
  - The nature of sleep (NREM, REM)
  - Changes in sleep patterns over the course of the lifespan, especially during college years
  - Prevalence of sleep disorders and correlates of sleep disturbances
- Self-monitoring
  - Review sleep diary
  - Reinforce participant for self-monitoring
- Brief program overview
  - Behavioral: changing maladaptive sleep habits
  - Cognitive: reframing dysfunctional beliefs and attitudes about sleep
  - Educational: review of strategies promoting good sleep hygiene (limiting caffeine, avoiding exercise too close to bedtime; understanding the effect of alcohol on sleep)
- Social learning explanation of sleep disturbance
  - Describe contributing factors: predisposing, precipitating, perpetuating factors
  - Review conceptual model of insomnia
  - Relate this model to the patient's personal sleep problem history
- Sleep Diary Reminder
- Sleep hygiene ideas (Handout: College Student Sleep Tips)
  - E.g., caffeine, nicotine and alcohol use; diet; exercise; sleep environment

Appendix B. Sleep 101 Workshop 2 Outline

- Self-monitoring
  - Review sleep diary
  - Reinforce participant for self-monitoring
- Introduction of behavioral (sleep restriction and stimulus control) CBTi procedures
  - Review of problems encountered on your own and generation of methods to enhance adherence to good sleep practices (e.g., identify non-striving activities to engage in during stimulus control; identify cues to determine sleepiness and time to return to bed; use alarm clock to maintain regular arising time)
- Introduction of cognitive components of CBTi
  - Introduce and discuss clinical relevance of this framework with regard to insomnia
  - Identify, challenge, and replace dysfunctional cognitions (presented through vignettes)
- Identify misperceptions about the causes of insomnia
- Alter dysfunctional beliefs about the impact of insomnia
- Modify unrealistic sleep expectations
- Enhance perceptions about good sleep practices
- Dispel myths about good sleep practices
- Relapse prevention – What do I do when I'm on my own?
  - Make distinction among lapse, relapse, and collapse
  - Discuss the inevitability of having an occasional poor night's sleep and caution against interpreting this as evidence that chronic insomnia has returned
  - Identify high-risk situations
- Negative emotional states (e.g., stress, anxiety, depression)
- Positive emotional states (e.g., anticipation of a trip)
  - Give tips for coping with the inevitable
- Stay calm – no need to panic, it just makes things worse
- Analyze antecedents or precipitating circumstances
- Reinstate restriction of time in bed and follow stimulus control procedures
- Ask for further help – phone call, booster session
  - Give tips for coping with daytime sequelae of insomnia
- Change the timing of scheduled activities
- Engage in sensory stimulation and time management to increase performance
- Increase tolerance to sleep loss (Handout: Time Management)