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Association Between Sleep Hygiene and Sleep Quality in Medical Students

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Abstract

The aim of this study was to determine whether subjective sleep quality was reduced in medical students, and whether demographics and sleep hygiene behaviors were associated with sleep quality. A Web-based survey was completed by 314 medical students, containing questions about demographics, sleep habits, exercise habits, caffeine, tobacco and alcohol use, and subjective sleep quality (using the Pittsburgh Sleep Quality Index). Correlation and regression analyses tested for associations among demographics, sleep hygiene behaviors, and sleep quality. As hypothesized, medical students' sleep quality was significantly worse than a healthy adult normative sample (t = 5.13, $p < .001$). Poor sleep quality in medical students was predicted by several demographic and sleep hygiene variables, and future research directions are proposed.

Entering medical school presents students with increased academic pressures and stress levels, and these new demands instigate changes in sleep and work habits. Research shows that, although medical students exhibit good health behaviors compared with other young adults (Frank, Carrera, Elon, & Hertzberg, 2006), they also demonstrate significant changes to these habits as their education continues. Alcohol consumption increases during medical school (Ball & Bax, 2002), and decreases have been shown for exercise, as well as sleep duration, among physicians and medical trainees (Hull, DiLalla, & Dorsey, 2008).

Sleep hygiene has been defined as those behaviors that are believed to promote improved quantity and quality of sleep (Stepanski & Wyatt, 2003). Research in other healthy adult populations shows that evening activities and conditions while falling asleep affect sleep quality (Brown, Buboltz, & Soper, 2002; Mastin, Bryson, & Corwyn, 2006). Other sleep hygiene recommendations include decreasing schedule irregularity; nighttime exercise; and caffeine, alcohol, and tobacco use (Stepanski & Wyatt, 2003). Activities in bed, such as reading or watching television, have also been associated with subjective measurements of poor sleep (Mastin et al., 2006).

Sleep is of particular interest in medical student populations because of the relationship between sleep and stress (Kim & Dimsdale, 2007) and the potential impact on quality of patient care (Owens, 2001). Sleep loss, as measured by daytime sleepiness, has been shown to negatively impact academic performance in medical students (Rodrigues, Viegas, Abreu, & Tavares, 2002). One sample of Estonian medical students demonstrated an association between poor sleep quality and academic progress (Veldi, Aluoja, & Vasar, 2005). Another study among medical students found that exam anxiety, environment, and irregular schedules contributed to poor sleep quality (Feng, Chen, & Yang, 2005). Recently, Frank et

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al. (2006) described demographics and sleep duration in a large sample of U.S. medical students, finding a relationship between increased class year and lower sleep duration. Although the literature on medical students and sleep quality is limited, it suggests this population is at particular risk for sleep loss and poor sleep quality, both of which may have measurable consequences on academic performance and quality of patient care.

This study extends the understanding of sleep in medical students in a U.S. sample. Previous studies using the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) have not used U.S. medical students and have been limited to the examination of just a few sleep hygiene behaviors. This study includes a wide set of demographic and sleep hygiene variables. The PSQI is the gold standard questionnaire for assessing subjective sleep quality and has been validated in both clinical populations (Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002) and non-clinical populations, including college and graduate students (Carney, Edinger, Meyer, Lindman, & Istre, 2006; Howell, Jahrig, & Powell, 2004). In this sample, we hypothesized that medical students would report worse sleep quality in comparison to published normative samples of healthy, young adults. In addition, we expected that poor sleep hygiene practices (e.g., studying and watching television in bed) and poor lifestyle behaviors (e.g., alcohol and caffeine use and fewer days of exercise) would correlate with worse sleep quality, as measured by the PSQI. We also hypothesized that demographics and poor sleep hygiene practices would predict self-reported sleep duration.

METHOD

Participants

Participants were 314 medical students from a university in the Pacific Northwest of the United States. Ages ranged from 21 to 43 years ($M = 27.8$, $SD = 4.0$). Respondents included slightly more female than male students (57.9%; $n = 175$). Participants were sampled in cross-sectional designs across all 4 years of medical school. Descriptive statistics of age and gender by class year appear in Table 1. The students primarily identified themselves as White (81.9%; $n = 249$) and Asian (12.5%; $n = 38$), comparable to the student body proportions of White (72.5%) and Asian (15.0%) for the class of 2011.

Procedures

Participants were recruited through e-mail to an anonymous survey for all currently enrolled medical students at the university. Students were e-mailed a total of three times across 3 weeks in March 2008. The response rate was 61% ($N = 314$). The Web-based survey contained 41 questions about demographics, sleep and exercise habits, caffeine, tobacco and alcohol use, and included the PSQI. Participants gave informed consent to begin the survey. The study was approved by the institutional review board of the study site. Participants who completed the survey were invited to enter a lottery to receive an online gift certificate.

Measures

Demographics, sleep hygiene, and lifestyle behaviors—Participants completed demographic questions to assess age, year in medical school, gender, race, ethnicity, whether they had a steady bed partner (partnered status), and whether they lived with children in the home. Sleep hygiene was assessed by 10 questions regarding exercise; evening and bedtime activity; and caffeine, tobacco, and alcohol use. Caffeine intake was measured by reported coffee, soda, caffeinated tea, and energy drinks consumed in a typical day. Sleep habits were assessed by reported frequency of bedtime activities, such as reading or watching television in bed, and tobacco and alcohol use after 6 p.m. Responses were made on a 6-point scale ranging from 1 (*never; 0% of the time*) to 6 (*always; 100% of the*

time), except for caffeine use, which was assessed quantitatively. Participants also indicated their exercise habits, which we measured as a lifestyle behavior by exercise frequency. In analyses, we use number of days of 30+ min of exercise. The time frame for responses was the previous month, consistent with the following PSQI.

Sleep quality—Participants completed the PSQI (Buysse et al., 1989), a 19-item survey to assess sleep quality over the previous month. It yields seven subscales: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Participants responses were scored on a 3-point scale, ranging from 0 (*no difficulty*) to 3 (*severe difficulty*). The subscales combine to provide a global sleep quality score. Higher scores indicate poorer sleep quality, and a global score of 5 has been established as the clinical cutoff. The PSQI has been used previously to measure sleep quality in healthy adults (Grandner, Kripke, Yoon, & Youngstedt, 2006; Monk, Reynolds, Buysse, DeGrazia, & Kupfer, 2003) and in university students (Aloba, Adewuya, Ola, & Mapayi, 2007; Carney et al., 2006).

Statistical Analysis

Descriptive statistics including frequencies and means were calculated from the demographics, sleep hygiene behaviors, and PSQI global scores. Tobacco use was queried for weekend and weekday evenings and, because the responses were highly correlated ($r = .93$, $p < .001$), we averaged the values for a single score of evening use. Weekday and weekend evening alcohol use was also highly correlated ($r = .79$, $p < .001$), and scores were averaged for evening alcohol consumption. Finally, primary hypothesis testing was conducted using *t* tests and correlation and regression analyses. Global sleep quality was compared to healthy norms (Carney et al., 2006) using a one-sample *t* test. Multiple regression models were tested to predict sleep quality and sleep duration from demographic and sleep hygiene variables. All statistics were performed using SPSS v. 15.0 (Chicago, IL).

RESULTS

Sleep Hygiene

Participants reported very little evening tobacco use: 94.9% of students ($n = 277$) reported no use at all. In contrast, most students (59.6%; $n = 177$) reported drinking alcohol in the evening “once in a while” or “sometimes.” Caffeine use was moderate: quantitative results for tea, coffee, soda, and energy drinks were weighted for caffeine content and summed to yield the equivalent of cups of coffee consumed on a typical day ($M = 1.67$, $SD = 1.48$; $n = 296$).

Most of the participants (65.7%; $n = 195$) reported never watching television in bed. Of those who did, the majority (18.9%; $n = 56$) reported doing so only “once in a while.” Most students reported studying in bed (56.1%; $n = 164$); however, fewer than 5% reported studying in bed “frequently, if not always” or “always.” The majority of students reported exercising 30+ min at least 3 days per week (66.6%; $n = 199$).

Sleep Quality

Means were computed for each of the seven subscales of the PSQI (see Table 2). Subjective sleep quality, sleep duration, sleep disturbances, and daytime dysfunction all had means above 1, identifying these areas as contributing most to the global PSQI score. Sleep latency, sleep efficiency, and the use of sleep medication had means below 1.

The mean PSQI global score was 6.37 ($SD = 2.57$); and, as hypothesized, many students were above the clinical cutoff (≥ 5) for poor sleep quality: 50.9% ($n = 148$). In a one-sample

t test comparing our medical student sample to a contemporary college-age sample (Carney et al., 2006) on the PSQI global score, the medical students had significantly worse self-reported sleep quality ($t = 5.13$, $p < .001$).

Associations Between Demographics, Sleep Hygiene, Lifestyle Behaviors, and Sleep Quality

Relationships between demographics, sleep hygiene, lifestyle behaviors, sleep quality (relevant PSQI subscales and global score), and sleep duration were examined (see Table 3). Poor sleep quality, including increased daytime dysfunction ($r = .12$, $p < .05$) and poorer global sleep quality scores ($r = .13$, $p < .05$), were associated with being single. In addition, poor sleep quality including shorter sleep duration, increased daytime dysfunction, and poorer global sleep quality was related to several sleep hygiene and lifestyle behaviors: infrequent exercise, watching television in bed, and studying in bed. Tobacco use was associated with poorer global sleep quality ($r = .16$, $p < .01$).

Linear Regression to Predict Poor Sleep Quality

A linear regression (see Table 4) was conducted to test a predictive model for sleep quality with demographic variables (class year, age, gender, whether they had a steady bed partner, and whether they lived with children in the home) and sleep hygiene behaviors (caffeine, tobacco, and alcohol use; watching television in bed; studying in bed; and days per week of 30+ min of exercise). The overall model was significant ($R^2 = .17$), $F(11, 262) = 4.80$, $p < .001$. Age predicted sleep quality ($\beta = .11$, $p < .05$), with older students sleeping worse than younger students. Whether a student was partnered also predicted sleep quality ($\beta = -.95$, $p < .05$), with single students sleeping worse. Watching television in bed ($\beta = .38$, $p < .01$), studying in bed ($\beta = .39$, $p < .01$), and fewer days of 30 min of exercise ($\beta = .21$, $p < .01$) were also significant predictors of poor sleep quality. Class year; gender; presence of children in the home; and caffeine, tobacco, and alcohol use were not significant predictors in this model.

Sleep Duration: Comparison to National Norms and Effect of Class Year

Participants reported an average total sleep duration of 6 hr and 38 min per night ($SD = 1.12$). This duration was not different ($t = 1.65$, $p = .10$) than that reported by similar age respondents in the 2005 Sleep in America Poll (NSF, 2005), which found that adults aged 18 to 49 reported sleeping 6 hr and 45 min per night, on average. However, there was an interaction between class year and sleep duration in our sample ($F = 7.130$; $R^2 = .069$; $p < .000$), where sleep duration was similar for 1st- and 2nd-year students (6 hr and 39 min and 6 hr and 35 min, respectively), shortest for 3rd-year students (6 hr and 16 min), and longest for 4th-year students (7 hr and 1 min).

DISCUSSION

In general, medical students had adequate sleep hygiene behaviors and reported similar sleep duration to age-matched national norms. However, over one half of our sample (50.9%; $n = 148$) met the clinical cutoff of the PSQI for poor sleep quality, demonstrating considerably worse sleep quality than a published comparison group of university students (Carney et al., 2006). The PSQI subscale means suggest that subjective sleep quality, sleep duration, sleep disturbances, and daytime dysfunction most strongly contributed to the elevated PSQI global scores. Sleep quality was predicted with a model accounting for demographics and sleep hygiene behaviors. Of the surveyed sleep hygiene behaviors, only watching television in bed was significant as a sleep hygiene risk factor. Age emerged as a predictor and is of particular interest since one study of younger and older adults showed no difference between PSQI scores based on age (Grandner et al., 2006). This suggests a potential interaction between

age and being in medical school that affects sleep quality. Class year, however, had the opposite relationship: earlier class years reported worse sleep quality than later class years. It is possible that later-year students may have developed better coping strategies for their curriculum. As hypothesized, regular exercise predicted sleep quality. There is much anecdotal evidence for this relationship, but the literature on young, healthy adults is scant. Several studies show that regular exercise improves subjective sleep quality in older adults (e.g., King, Oman, Brassington, Bliwise, & Haskell, 1997).

The interaction between class year and sleep duration was not hypothesized. The measured sleep duration was not different from a sample of 2,316 U.S. medical students who reported 6 hr and 48 min per night (Frank et al., 2006). Third-year students had the shortest sleep duration, although the overall model shows that sleep duration increased with class year. The above comparison sample showed a significant effect of class year in the same direction (Frank et al., 2006). This relationship is relevant to educators since particular curriculum components, such as clinical rotation, may contribute to shorter sleep duration. The literature suggests sleep quality worsens in medical students during residency (Rosen, Gimotty, Shea, & Bellini, 2006), so improving sleep quality earlier in medical school is a protective opportunity for medical students. Future research is needed to examine the relation between sleep, class year, and academic performance.

Study findings should be interpreted in light of several limitations. Our sample may not be generalizable to the broader population of medical students in the United States or other countries; in particular, the average age in our sample was 27.8 years, which is older than the national median of 25 years (Frank et al., 2006), and the comparison to sleep duration from the Sleep in America Poll (NSF, 2005) was taken from a wider demographic than sampled in this study. We did not use a local control group for comparison of sleep quality. In addition, self-report questionnaires were used to measure sleep hygiene behaviors and sleep quality, introducing potential reporter bias. Use of a standardized sleep hygiene scale could make it easier to compare sleep hygiene results with other populations. An objective measurement of sleep pattern, such as actigraphy, could provide additional information on the relationship between sleep and sleep hygiene behaviors in medical students. Data were sampled at a single time of the year, introducing potential confounds of resident rotation, seasonal effects, or other temporary sleep changes. The cross-sectional design of the survey limits our ability to measure how sleep quality changes as students progress through class years; longitudinal study designs would allow for examining the evolution of sleep hygiene over the course of medical school. Other studies have shown caffeine and alcohol use to have a deleterious effect on sleep quality, although we did not find any relationships between substance use and sleep quality in our sample. Our retrospective measure of substance use may have yielded differing results for this study. Our model accounted for only 17% of the variance in PSQI scores, suggesting other factors not included in this study also contribute to sleep quality. Aspects of medical school curriculum, such as clinical rotation, may also be important contributors to sleep.

The majority of this medical student sample reported poor sleep quality, which is of concern to educators. It may be that adequate sleep hygiene behaviors for the general population are not enough to protect sleep in medical students. Further studies on medical students are needed, with local comparison populations and including a more comprehensive screening of individual (e.g., anxiety, depression, sleep attitudes) and school-related (e.g., academic schedule) risk factors with objective sleep outcomes. Sleep quality in medical students may be improvable through sleep hygiene education programs (Arora, Georgitis, Woodruff, Humphrey, & Meltzer, 2007; Ball & Bax, 2002; Buysse et al., 2003).

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TABLE 1

Age and Gender by Class Year

	Gender					
	Male		Female		Age	
Class Year	n	%	n	%	M	SD
First	34	43.6	44	56.4	26.8	4.6
Second	30	45.5	36	54.5	27.7	4.1
Third	39	49.4	40	50.6	28.5	4.0
Fourth	24	30.4	55	69.6	28.4	4.0

TABLE 2

Pittsburgh Sleep Quality Index (PSQI) Global and Subscale Means

Sleep Quality	M	SD
Global PSQI	6.37	2.57
Subscales		
Subjective sleep quality	1.49	0.76
Sleep latency	0.81	0.81
Sleep duration	1.22	0.92
Sleep efficiency	0.18	0.46
Sleep disturbances	1.20	0.54
Use of sleep medications	0.43	0.85
Daytime dysfunction	1.04	0.75

TABLE 3

Correlations Between Demographics, Sleep Hygiene Behaviors, and Sleep Quality (Relevant PSQI Subscales and Global Score)

	r				
Variable	**Subjective Sleep Quality[c]**	**Sleep Duration[c]**	**Sleep Disturbances[c]**	**Daytime Dysfunction[c]**	**PSQI Global[c]**
Class year[d]	.131	−.055	−.028	−.051	−.078
Age	.087	.094	.046	.018	.089
Gender[a,d]	−.053	−.116*	.114	.097	−.005
Partnered status[b,d]	.089	−.076	−.078	−.121*	−.132*
Children in the home[b,d]	.043	.121	.021	−.026	−.007
Caffeine use	−.092	.075	−.032	.111	.081
Tobacco use	.006	.097	.097	.073	.163**
Alcohol use	−.028	−.072	.009	−.027	.015
Watching television in bed	−.066	.259**	.067	.282**	.242***
Studying in bed	−.108	.195**	.057	.218**	.247***
Days of 30 min of exercise	−.073	−.144*	−.086	−.201**	−.231***

Note. PSQI = Pittsburgh Sleep Quality Index.

[a]Coded as male = 1, female = 2.

[b]Coded as no/false = 0, yes/true = 1.

[c]Higher PSQI scores indicate worse sleep.

[d]Spearman correlation coefficient.

*p < .05.

**p < .01.

***p < .001.

TABLE 4

Linear Regression Predicting Sleep Quality (PSQI global)

	Sleep Quality	
Variable	**t**	**Standardized β**
Class year	−1.37	−.19
Age	2.19	.11*
Gender	−1.29	−.42
Partnered status	−2.49	−.95*
Children in the home	0.19	.11
Caffeine use	0.54	.06
Tobacco use	1.15	.35
Alcohol use	−0.60	−.09
Watching television in bed	2.48	.38*
Studying in bed	2.80	.39**
Days of 30 min of exercise	−2.66	−.21**

Overall model: $R^2 = .17$; $F(11, 262) = 4.80$, $p < .001$.

* $p \leq .05$.

** $p < .01$.