RESEARCH

Sleep Quality Among Pharmacy Students

Marshall E. Cates, PharmD,^a Andraya Clark, PharmD,^b Thomas W. Woolley, PhD,^c and Amy Saunders, PharmD^d

^a Samford University McWhorter School of Pharmacy, Birmingham, Alabama

^b Ireland Army Community Hospital, Fort Knox, Kentucky

^c Samford University Brock School of Business, Birmingham, Alabama

^d Publix, Birmingham, Alabama

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Objective. To determine the quality of sleep among pharmacy students in the didactic portion of the curriculum at one school of pharmacy.

Methods. The study consisted of an anonymous, voluntary survey that included the Pittsburgh Sleep Quality Index (PSQI), a self-rated instrument that measures sleep habits for a month.

Results. The survey was completed by 253 students. Students in the lower grade point average (GPA) category had higher scores on 2 of 7 components of the PSQI and on the global score. Poor sleep quality, indicated by a global PSQI score of greater than 5, was reported by 140 students. The rate of poor sleeping was higher among students in the lower GPA category.

Conclusion. Poor sleep quality was pervasive among surveyed pharmacy students in the didactic portion of the pharmacy school curriculum, especially among those with lower GPAs.

Keywords: sleep, pharmacy students, grade point average

INTRODUCTION

Sleep is a vital component of one's health, well-being, and functioning.¹ Unfortunately, approximately 70 million Americans experience chronic sleep problems.¹ College students are even more likely than the general public to report sleep disturbances,² and studies reveal a considerable prevalence of sleep disturbances in this population.³⁻⁶ Moreover, various sleep measures, including length of sleep, consistency of sleep, frequency of sleep problems, and satisfaction with sleep, have all worsened in the college student population over the past several decades.⁷ Female college students may have more difficulty than male college students with sleep disturbances;^{3,6} however, this finding is inconsistent.^{5,8} A chief concern of inadequate sleep among college students is the detrimental effects it can have on the 3 brain processes associated with learning: acquisition, consolidation, and recall.⁹ Studies have found a correlation between sleep disturbances and decreased academic performance in college students.^{6,8,10,11}

Various studies have examined the sleep of medical, nursing, and pharmacy students. Sleep difficulties have

been reported among Saudi Arabian, Brazilian, and Estonian medical students, and were associated with decreased academic performance.¹²⁻¹⁴ German medical students with lower sleep quality in the months leading up to the preclinical board examination performed more poorly on the examination.¹⁵ Furthermore, American medical students participating in clerkship experiences reported sleep deprivation subjectively impaired their ability to care for patients¹⁶ and objectively caused a decreased ability to perform on cognitive function tests after on-call duty.¹⁷ Among Italian nursing students, insomnia was common and poor sleep quality was associated with unsatisfactory academic progress.¹⁸

Published literature regarding pharmacy students' sleep is scarce. Adeosun et al found that habitual night reading (defined as 8 pm or later) among Nigerian students had a negative effect on sleep quality, which in turn correlated negatively with academic performance.¹⁹ Taher et al found high levels of sleep complaints and excessive daytime sleepiness in Libyan pharmacy students.²⁰ Finally, Jain et al found that subjectively-rated academic progress was one of the factors significantly correlated with sleep quality among female Indian pharmacy students, who reported frequent sleep-associated problems.²¹

Questions remain regarding sleep quality of students in US colleges and schools of pharmacy. There is literature regarding undergraduate students' sleep in American

Corresponding Author: Marshall E. Cates, PharmD, Samford University McWhorter School of Pharmacy, 800 Lakeshore Drive, Birmingham, AL 35229. Tel: 205-726-2457. Fax: 205-726-2669. E-mail: mecates@samford.edu

colleges and universities, but the majority of literature regarding health professions students' sleep is from foreign universities, whose programs, students, and cultures can vary from those in the United States. Furthermore, most sleep-related literature in the health professions centers on medical students, and there are important differences between medical and pharmacy education, such as educational background and curricular structure. It is conceivable that stress levels and their corresponding effects on sleep could differ between students of different programs.

An additional concern is the association between sleep quality and factors such as academic performance, gender, and academic level. The literature is consistent in regard to the association between sleep quality and academic performance. Some studies have found that female students experienced more difficulty with sleep than their male counterparts,^{3,6,12} but others have not.^{5,8,18} This issue would be of interest to U.S. pharmacy schools, as the majority of students are female. Few studies have examined the sleep of students at different academic levels, and the results have been mixed.^{12,18,20}

Thus, we examined the quality of sleep among pharmacy students in the didactic portion of their curriculum at one US school of pharmacy. Our primary objective was to characterize the sleep quality of pharmacy students, including determining poor sleepers. Our secondary objectives were to determine associations between sleep quality characteristics and students' gender, year in the curriculum, and GPA range, and to determine associations between overall sleep quality (ie, good sleep or poor sleep) and students' gender, year in the curriculum, and GPA range.

METHODS

The study was an anonymous survey of pharmacy students in the first-year, second-year, and third-year classes. Student participation in the survey was voluntary and they did not receive incentives (eg, prize lottery, extra credit) for their participation. The project was approved by the university's Institutional Review Board. The survey was administered in class on a single day in the middle of the spring semester, and the investigators secured permission of instructors to administer the survey at the end of class time. The date was chosen with meticulous attention given to examination schedules of the class cohorts in order to ensure a similar pattern of prior and future examinations. Specifically, each class cohort had 2 major examinations in the 2 weeks prior to administration of the survey, 1 major examination in the 2 weeks following administration of the survey, and there were no imminent examinations.

The survey included demographic questions (ie, gender, year in the curriculum, GPA range) and the Pittsburgh

Sleep Quality Index (PSQI), a clinical instrument that measures sleep quality. Buysse et al noted that sleep quality was a widely used clinical construct, but it represented "a complex phenomenon that is difficult to define and measure objectively."²² Importantly, sleep quality is a largely subjective experience that includes both quantitative (eg, duration) and qualitative (eg, depth) aspects. The PSQI was developed in order to assess an array of sleep disturbances that might affect sleep quality and to distinguish between those with good sleep quality and those with poor sleep quality.²²

The PSQI is a self-rated instrument that measures sleep habits for one month. The index is comprised of 19 items, which are combined to form 7 component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Subjective sleep quality refers to how a person would self-rate his/her sleep quality overall on a scale of "very good" to "very bad." Sleep latency is a measure of how long it takes for the person to fall asleep. Habitual sleep efficiency is a measure of the number of hours slept in relation to the number of hours spent in bed. Finally, sleep disturbances refer to a range of issues that adversely affect sleep, including waking up during the night or early morning, having to get up to use the bathroom, uncomfortable breathing, coughing or snoring loudly, feeling too hot or too cold, having bad dreams, and having pain. Each component score has a range of 0 (no difficulty) to 3 (severe difficulty). The 7 component scores are added to yield a global score, which ranges from 0 to 21. A global score less than or equal to 5 indicates good sleep, whereas a score greater than 5 indicates poor sleep. The PSQI has an overall reliability coefficient (Cronbach's α) of 0.83 for its 7 components, and a global cutoff score of 5 has a sensitivity of 89.6% and a specificity of 86.5% in distinguishing good from poor sleepers.²²

Two independent group *t* tests and 1-way analysis of variance were used to compare component and total score means by gender, year in the curriculum, and GPA range. Pearson's chi-square test was used to compare the rates of good sleepers vs poor sleepers by gender, year in the curriculum, and GPA range.

RESULTS

The survey was completed by 253 of 375 (67%) students, including 161 females and 90 males (2 surveys provided no information concerning gender), 100 first-year, 67 second-year, and 86 third-year students. Forty-seven students indicated a GPA range of 2.00-2.99, 112 students indicated a GPA range of 3.00-3.49, and 89 students indicated a GPA range of 3.50-4.00 (5 surveys

provided no information concerning GPA range). The gender categorization and GPA ranges of students who responded to the survey (64% female, 36% male; 19% with GPA ≤ 2.99 , 45% with GPA 3.00-3.49, 36% with GPA ≥ 3.50) were similar to those of the eligible student pool (62% female, 38% male; 25% with GPA ≤ 2.99 , 45% with GPA 3.00-3.49, and 30% with GPA ≥ 3.50). Mean PSQI sleep variables included the following: sleep onset latency of 21.3 $\pm$ 18.1 minutes; sleep at night of 6.8 $\pm$ 1.2 hours; and sleep efficiency of 90.0%.

Global PSQI scores for all students ranged from 0 to 16 and are depicted in Figure 1. Mean component scores and the mean global score for all students are shown in Table 1. The mean global score for all students was 6.19 ± 2.93 . Mean PSQI scores based on gender, year in the curriculum, and GPA are shown in Tables 1-3. Male students had a higher score than female students on sleep duration, but the global PSQI scores for the 2 genders did not differ. Third-year students had a lower score on sleep duration relative to first-year and second-year students, but the global PSQI scores for the 3 classes did not differ. The most striking results were those concerning GPA ranges. The students in the lower GPA category (2.00-2.99) had numerically higher scores on all 7 components relative to those with intermediate (3.00-3.49) and higher (3.50-4.00) GPAs. Two of those component scores—sleep efficiency and use of sleeping medication—were significant. Students in the lower GPA category had a significantly greater global PSQI score compared to students in the other 2 GPA categories.

Poor sleep quality, which was indicated by a global PSQI score >5 , was reported by 140 (55%) students. Table 4 shows the associations between the demographic variables and overall sleep quality. There was no relationship between either gender or year in the curriculum and overall sleep quality. However, students in the lower GPA category had poorer sleep quality compared to students in

the other 2 GPA categories. Approximately 75% (74.5%) of students in the lower GPA category were rated as poor sleepers compared to 45.5% of students in the intermediate GPA category and 56.2% of students in the higher GPA category ($p=0.003$).

DISCUSSION

Our results revealed that a majority of pharmacy students in the didactic portion of the curriculum suffer from poor quality sleep. To place these findings into perspective, the mean global score of 6.2 and the 55% prevalence of poor sleepers were similar to those found in a study of postpartum women (median and mean infant age of approximately 8 weeks), who had a mean global score of 6.3 and a 57.7% prevalence of poor sleepers.²³ Some studies involving undergraduate students,^{4,5} medical students,^{13,15} and pharmacy students¹⁹ also used the PSQI as the standard sleep scale. While all of these studies reported the percentage of poor sleepers, only 3 of them reported mean global scores,^{4,15,19} and only 1 reported mean component scores.¹⁹ Our finding of a 55% prevalence of poor sleepers was generally comparable to that found by Lund et al⁵ (66%), Ahrberg et al¹⁵ (59% in pre-examination period), and Adeosun et al¹⁹ (63% in habitual night readers), but greater than that found by Kang and Chen⁴ (34%) and Medeiros et al¹³ (39%). Our finding of mean global score of 6.2 was similar to that found by Ahrberg et al (6.3 in pre-examination period), and Adeosun et al (6.4 in habitual night readers), but greater than that found by Kang and Chen (approximately 4.9). Comparing our mean component scores to those found by Adeosun et al, our students showed more difficulty with sleep latency, whereas the Nigerian students showed more difficulty with sleep duration. Additionally, our students consumed more sleep medication and suffered more daytime dysfunction. Taken as a whole, our findings more closely resembled those of Ahrberg et al (pre-examination period) and Adeosun et al, which might be because those 2 studies also involved students in the health professions. Our findings differed most from those of Kang and Chen, which might be because they examined undergraduate students and/or because the results might reflect differences between Eastern and Western cultures regarding sleep habits.

The sleep quality of female students was not worse than that of male students in terms of component PSQI scores, global PSQI score, or prevalence of poor sleepers. In fact, the only significant gender finding was that male students had more difficulty with sleep duration relative to female students. The sleep quality of students in the 3 class cohorts did not differ regarding global PSQI score or prevalence of poor sleepers. Although the credit hours of

Figure 1. Global Pittsburgh Sleep Quality Index Scores (n = 253)

Table 1. Mean Pittsburgh Sleep Quality Index (PSQI) Scores by Gender

	All Students (n=253)	Female (n=161)	Male (n=90)	Significance
Subjective sleep quality	0.96 ± 0.68	0.93 ± 0.68	0.99 ± 0.67	NS
Sleep latency	1.16 ± 0.90	1.13 ± 0.93	1.21 ± 0.83	NS
Sleep duration	1.07 ± 0.88	0.98 ± 0.88	1.23 ± 0.85	p=0.031
Sleep efficiency	0.35 ± 0.66	0.35 ± 0.66	0.35 ± 0.68	NS
Sleep disturbances	1.14 ± 0.47	1.17 ± 0.50	1.09 ± 0.42	NS
Use of sleeping medication	0.37 ± 0.73	0.40 ± 0.70	0.33 ± 0.78	NS
Daytime dysfunction	1.18 ± 0.72	1.19 ± 0.74	1.16 ± 0.71	NS
Global PSQI	6.19 ± 2.93	6.12 ± 2.89	6.29 ± 3.03	NS

our program were evenly divided over the first 3 years and there were no overt variations regarding overall academic difficulty, we had assumed that more advanced students would fare better than first-year students in this regard because they would have had more experience in handling the academic rigor of the program. Yet, the only significant finding was that third-year students had less difficulty with sleep duration relative to students in the other 2 classes. The third-year students did, however, have the lowest numerical mean global PSQI score and lowest prevalence of poor sleepers. Finally, we found an association between the lowest GPA range (2.00-2.99) and prevalence of poor sleepers, global PSQI score, and component scores of sleep efficiency and use of sleeping medication. This finding among our pharmacy students is consistent with findings from other studies on undergraduate college students, medical students, and nursing students.^{6,8,10-14,18}

Strengths of the study included a large sample size with a satisfactory response rate, use of a standardized measure of sleep quality, and careful selection of an administration date that minimized a potential confounding variable across class cohorts. However, there were limitations as well. First, we relied on student self-reported GPA range; therefore, some students who were close to a particular cutoff point may have had to guess which category was applicable to them. We preferred to have an anonymous survey so students would feel more comfortable answering questions. Second, we could have used

additional sleep-related rating scales (eg, Epworth Sleepiness Scale) and inquired about more demographic variables (eg, work hours, exercise habits, caffeine use, spouse/children) in order to find associations. However, we wanted to focus on sleep quality, and our goal was to make the survey concise enough in order to increase the likelihood of student participation. Finally, because the survey involved students at just 1 school of pharmacy, the results cannot necessarily be generalized to other schools. We looked at this study as a means to obtain pilot data.

Our findings are significant in that they show the extent of sleep difficulties in 1 US pharmacy school. Our findings point to the need to address the sleep quality of our student body specifically, but the findings also compel us to recommend that other US pharmacy schools examine the sleep quality of their students. Furthermore, our findings add to an accumulating body of literature that supports an association between sleep and academic performance. Given this fact, it is somewhat surprising that the broader academic community has not paid more attention to the issue, and again, we would encourage other pharmacy schools to consider the importance of the issue. It appears that faculty members may be able to enhance students' academic success by addressing students' sleep habits,¹⁰ particularly those who are struggling academically. Of course, it might be difficult for faculty members to recognize the importance of this issue and to promote good sleep hygiene practices in students if they

Table 2. Mean Pittsburgh Sleep Quality Index (PSQI) Scores by Year in the Curriculum (n=253)

	First	Second	Third	Significance
Subjective sleep quality	0.92 ± 0.70	1.05 ± 0.71	0.93 ± 0.63	NS
Sleep latency	1.02 ± 0.90	1.15 ± 0.94	1.31 ± 0.84	NS
Sleep duration	1.26 ± 0.80	1.21 ± 0.88	0.76 ± 0.88	p<0.001
Sleep efficiency	0.27 ± 0.51	0.42 ± 0.76	0.40 ± 0.72	NS
Sleep disturbances	1.08 ± 0.44	1.21 ± 0.48	1.16 ± 0.48	NS
Use of sleeping medication	0.35 ± 0.78	0.35 ± 0.71	0.42 ± 0.69	NS
Daytime dysfunction	1.25 ± 0.75	1.27 ± 0.71	1.02 ± 0.69	NS
Global PSQI	6.06 ± 2.90	6.64 ± 3.06	6.00 ± 2.85	NS

Table 3. Mean Pittsburgh Sleep Quality Index (PQSI) Scores by GPA Range (n=253)

	2.00-2.99	3.00-3.49	3.50-4.00	Significance
Subjective sleep quality	1.11 ± 0.63	0.88 ± 0.67	0.94 ± 0.66	NS
Sleep latency	1.30 ± 0.95	1.05 ± 0.83	1.20 ± 0.95	NS
Sleep duration	1.19 ± 0.85	1.04 ± 0.85	1.01 ± 0.93	NS
Sleep efficiency	0.57 ± 0.85	0.29 ± 0.59	0.29 ± 0.59	p=0.025
Sleep disturbances	1.26 ± 0.57	1.11 ± 0.43	1.12 ± 0.45	NS
Use of sleeping medication	0.62 ± 0.82	0.34 ± 0.71	0.27 ± 0.64	p=0.023
Daytime dysfunction	1.40 ± 0.68	1.10 ± 0.67	1.16 ± 0.80	NS
Global PSQI	7.45 ± 3.08	5.78 ± 2.74	5.93 ± 2.78	p=0.002

themselves have poor sleep habits, a possibility that may warrant investigation in its own right.

The intriguing question is what can be done to improve the sleep quality of pharmacy students. Perhaps providing information about sleep, sleep hygiene, and consequences of poor quality sleep during orientation and/or at other points in the pharmacy school curriculum could improve the situation. College students with poor sleep habits may be unaware that they have sleep difficulties and that academic performance can suffer as a result.² Knowledge of sleep hygiene is related to actual sleep practices, which consequently is related to overall sleep quality.²⁴ But unlike the typical college student, pharmacy students are in a health-related field, so it is tempting to assume that they would already have sufficient knowledge and awareness about sleep health. However, exposure to and/or retention of information concerning proper sleep hygiene and its relation to overall health and academic performance may be limited. An Australian study revealed that fourth-year pharmacy students obtained a mean score of only 35.5% on the Dartmouth Sleep Knowledge survey, which was significantly lower than the score of general community pharmacists.²⁵ Instruction regarding sleep disorders in clinical therapeutics courses is absent in about one-fifth of US pharmacy schools, and even when it does occur, a mean of only

approximately 1.5 hours is dedicated to the topic.²⁶ This issue is not unique to pharmacy, as proceedings from a conference on sleep and fatigue in medical trainees recommended sleep-related education for medical students and residents owing to their lack of education in the area.²⁷ And in a survey of US dental schools, Simmons and Pullinger revealed that time dedicated to education about sleep disorders was 0 hours in about one-fourth of schools and only 1-3 hours in about half of schools.²⁸ Psychoeducational programs are effective in reducing sleep difficulties in clinical populations.² A potentially successful educational program for students may include instruction regarding the detrimental effects of sleep difficulties on students' lives, sleep hygiene instructions (including sensible suggestions for changing aberrant sleep habits), and stimulus control instructions.^{2,24}

Further studies regarding the sleep of pharmacy students are needed and may want to address factors and habits that underlie poor sleep quality. Moreover, strategies to prevent or correct sleep difficulties of pharmacy students need to be developed and tested.

CONCLUSION

Poor sleep quality was pervasive among pharmacy students in the didactic portion of the pharmacy school curriculum, especially among students with lower GPAs.

Table 4. Associations Between Demographic Variables and Overall Sleep Quality (n=253)

Demographic variable	No. of good sleepers (%)	No. of poor sleepers (%)	Significance
Gender			NS
Female	72 (44.7)	89 (55.3)	
Male	41 (45.6)	49 (54.4)	
Year in the curriculum			NS
First	46 (46.0)	54 (54.0)	
Second	26 (38.8)	41 (61.2)	
Third	41 (47.7)	45 (52.3)	
GPA range			p=0.003
2.00-2.99	12 (25.5)	35 (74.5)	
3.00-3.49	61 (54.5)	51 (45.5)	
3.50-4.00	39 (43.8)	50 (56.2)	

This study points to the need for further evaluation of pharmacy students' sleep habits as well as the need for strategies to address poor sleep quality among pharmacy students.

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