ORIGINAL ARTICLE

Sleep Quality as a Predictor of Post-Clerkship Anxiety in Korean Medical Students: A Preliminary Report

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Objective: This study investigated whether preclinical year insomnia predicted post-clerkship anxiety and whether preclinical year depression predicted post-clerkship insomnia among Korean medical students. **Methods:** A total of 57 students (38 males and 19 females) aged 23–34 years (27.40 ± 2.76 years) completed questionnaires that included the hospital anxiety and depression scale, insomnia severity index, and morningness-eveningness assessment at the beginning and end of the clerkship. **Results:** A multiple linear regression analysis revealed that preclinical year sleep quality ($\beta=0.291$, $p=0.032$) was a statistically significant predictor of post-clerkship anxiety after controlling for pre-clerkship age, sex, and chronotype. Another multiple linear regression analysis revealed that preclinical year depression ($\beta=0.541$, $p<0.001$) was a statistically significant predictor of poor post-clerkship sleep quality, after controlling for age, sex, post-clerkship year anxiety, and chronotype. **Conclusion:** This study found that preclinical year insomnia may be related to post-clerkship anxiety. Post-clerkship insomnia was related to preclinical year depression. These findings may help medical school administrators reduce their students' anxiety and poor sleep through a cognitive behavioral approach and with psychological education.

Key Words: Sleep quality; Anxiety; Medical students; Clerkship

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INTRODUCTION

Anxiety, depression, and poor sleep quality are common among medical students in Brazil [1]. They are, however, just one example of the mental health problems experienced by medical students worldwide [1,2]. The global prevalence of anxiety among medical students was reported to be 33.8% [3]. Sustaining optimal mental health during medical training is crucial for students to become effective physicians [4]. Anxiety in medical students can have negative effects on both academic performance and patient care [5]. Anxiety is associated with poor sleep among medical students in several cross-sectional studies [6–10]. Poor sleep quality is also associated with depression in medical students [8,11]. However, until

now, few studies have been conducted on medical students to detect the causal relationship between insomnia and depression [12].

This study explores the relationship between insomnia and anxiety and/or depression among medical students using a prospective cohort design. It was hypothesized that baseline preclinical year insomnia might increase anxiety or depression in the post-clerkship period. Student insomnia may be predicted by preclinical year anxiety or depression.

METHODS

Design

This study is based on the group-III cohort of a prospective

cohort study, “A Study on the Physician-Patient Interactions of Medical Students” [13-15].

Participants

At the beginning of August 2014, the authors recruited 84 year-2 students from the medical school of Gyeongsang National University (GNU) in Jinju, Republic of Korea. Of these students, 57 (38 males and 19 females) aged 23–34 years (mean, 27.40 ± 2.76 years) completed questionnaires in September 2016, in their fourth year of study. Between 2014 and 2016, 12 students withdrew temporarily from school and 15 students did not complete the study questionnaires. The Institutional Review Board of GNU approved this study (IRB file number, GIRB-A14-Y-0051).

Assessment

The questionnaires completed by the students during years 2 and 4 included the Hospital Anxiety and Depression Scale (HADS) [16], Insomnia Severity Index (ISI) [17], and Morningness-Eveningness Questionnaire (MEQ) [18-20].

The HADS included 14 items divided equally into anxiety (HADS-A) and depression (HADS-D) categories. Each item is assigned a score from 0 to 3, and the cutoff scores for both sub-scales are both 8. The Korean version of the HADS is deemed to be valid and reliable [16]. The internal reliability in this study was adequate (HADS-A Cronbach's α for year-2 students=0.625, for year-4 students=0.622; HADS-D Cronbach's α for year-2 students=0.814, for year-4 students=0.793). The ISI was used to evaluate the sleep quality of the students. This instrument is a reliable and valid self-reported questionnaire for Koreans [17]. This assessment consists of seven items, each rated on a five-point Likert scale, and total scores range from 0 to 28. Higher scores represent more severe insomnia; the optimal cutoff score for Koreans is 15.5 [17]. The internal reliability in this study was adequate (Cronbach's α for year-2 students=0.626, for year-4 students=0.805). The MEQ was used to evaluate the chronotype of the students. This instrument consists of 19 items, and total scores range from 16 to 86. Higher scores represent a higher level of morningness. The Korean version of the MEQ is also reliable and valid [19,20]. The internal reliability of this study was adequate (Cronbach's α for year-2 students=0.808).

Statistical analysis

A multiple linear regression analysis was conducted to determine whether sleep quality at year 2 predicted anxiety levels at year 4 after controlling for age, sex, and year-2 chronotype. Another multiple linear regression analysis was performed to determine whether depression at year 2 predicted sleep quality at year 4 after controlling for age, sex, and year-2 chronotype and anxiety level. The forced entry method was used for both analyses for testing the hypotheses. Residual analyses were performed to assure that the models met the assumptions required for the analyses. All analyses were performed using SPSS for Windows software (version 25.0; IBM Corp., Armonk, NY, USA). A two-tailed

Table 1. Descriptive statistics for depression, anxiety, and insomnia in year-2 and year-4 medical students

Descriptive variables	Year 2	Year 4
	Mean $\pm$ SD (range)	Mean $\pm$ SD (range)
HADS-A		
Total students	6.91 $\pm$ 2.79 (1-13)	6.49 $\pm$ 2.69 (0-13)
Female	6.58 $\pm$ 2.34 (2-12)	5.74 $\pm$ 2.92 (0-12)
Male	7.08 $\pm$ 3.01 (1-13)	6.87 $\pm$ 2.53 (1-13)
HADS-D		
Total students	5.30 $\pm$ 3.10 (0-15)	4.95 $\pm$ 2.71 (0-12)
Female	4.42 $\pm$ 2.93 (0-10)	4.68 $\pm$ 3.27 (1-12)
Male	5.74 $\pm$ 3.13 (0-15)	5.08 $\pm$ 2.42 (0-10)
ISI		
Total students	7.67 $\pm$ 4.79 (0-18)	6.34 $\pm$ 4.43 (0-17)
Female	7.94 $\pm$ 6.13 (0-18)	6.00 $\pm$ 3.82 (0-17)
Male	7.54 $\pm$ 4.12 (0-17)	6.50 $\pm$ 4.73 (0-17)

Min: minimum value, Max: maximum value, SD: standard deviation, HADS-A: Hospital Anxiety and Depression Scale-anxiety sub-scale, HADS-D: Hospital Anxiety and Depression Scale-depression sub-scale, ISI: Insomnia Severity Index

p-value <0.05 was deemed to indicate statistical significance.

RESULTS

The ranges of HADS-A, HADS-D, and ISI scores for year-2 and year-4 students are presented in Table 1. The proportion of year-2 students with HADS-A scores higher than the cutoff was 42.1% (24 total, 18 males). The proportion of year-4 students with HADS-A scores higher than the cutoff was 29.8% (17 total, 14 males). The proportion of year-2 students with HADS-D scores higher than the cutoff was 19.3% (11 total, 8 males). The proportion of year-4 students with HADS-D scores higher than the cutoff was 17.5% (10 total, 6 males). The proportions of year-2 and year-4 students with ISI scores higher than the cutoff were 9.3% (5 total, 2 males) and 7.1% (4 total, 3 males), respectively.

Multiple linear regression analysis revealed that sleep quality during pre-clerkship ($\beta=0.291$, $p=0.032$) was a statistically significant predictor of post-clerkship anxiety level after controlling for age, sex, and chronotype in the pre-clerkship period (Table 2). In this first analysis, age, sex, and post-clerkship MEQ scores were used as independent variables. Another multiple linear regression analysis revealed that a higher level of depression at year 2 ($\beta=0.541$, $p<0.001$) was a statistically significant predictor of poor sleep quality at year 4 after controlling for year-4 age, sex, anxiety, and chronotype (Table 3). In this second analysis, age, sex, and post-clerkship HADS-A and MEQ scores were used as independent variables.

Our results revealed that sleep quality in year-2 medical students predicted year-4 anxiety levels after controlling for age, sex, and year-2 chronotype. Another finding was that the sleep quality in year-4 medical students was predicted by depression levels at year 2, after controlling for age, sex, year-2 anxiety, and year-2 chronotype. In this analysis, year-2 anxiety and year-2 chrono-

Table 2. Multiple linear regression model used to evaluate sleep quality and chronotype at year 2 as predictors of anxiety at year 4

	B	Standard error	β	p-value
Intercept	2.764	4.668	-	0.557
Age	0.131	0.136	0.130	0.341
Sex (female=0, male=1)	1.145	0.787	0.195	0.152
ISI score at year 2	0.167	0.076	0.291	0.032*
MEQ score at year 2	-0.047	0.040	-0.158	0.243

Dependent variable, resilience as measured by the Hospital Anxiety and Depression Scale–anxiety sub-scale (HADS-A). ISI: Insomnia Severity Index, MEQ: Morningness-Eveningness Questionnaire. $R^2=0.20$, adjusted $R^2=0.14$, $F=3.04$ ($p=0.026$), $n=53$. * $p<0.05$

Table 3. Multiple linear regression model used to evaluate depression, anxiety, and chronotype at year 2 as predictors of sleep quality at year 4

	B	Standard error	β	p-value
Intercept	0.176	7.196	-	0.981
Age	0.056	0.213	0.034	0.793
Sex (female=0, male=1)	-0.524	1.195	-0.055	0.663
HADS-D score at year 2	0.771	0.200	0.541	<0.001
HADS-A score at year 2	-0.013	0.217	-0.008	0.954
MEQ score at year 2	0.017	0.062	0.035	0.781

Dependent variable, resilience as measured by the ISI. HADS-D: Hospital Anxiety and Depression Scale–depression sub-scale, HADS-A: Hospital Anxiety and Depression Scale–anxiety sub-scale, ISI: Insomnia Severity Index, MEQ: Morningness-Eveningness Questionnaire. $R^2=0.28$, adjusted $R^2=0.21$, $F=3.827$ ($p=0.005$), $n=55$

type were not significantly related to post-clerkship sleep quality.

DISCUSSION

The results indicated that preclinical year insomnia predicted higher anxiety levels at year 4 after controlling for the students' age, sex, and preclinical chronotype. We also reviewed other studies that explored the association between sleep quality and anxiety in medical students [6-10]. One cross-sectional study showed that poor sleep quality as measured with Pittsburgh Sleep Quality Index (PSQI) was associated with significant anxiety [7]. Another study, conducted with 84 medical and 45 nursing students in their first year in 1967, reported that nighttime awakening was associated with symptoms such as palpitations, hand sweating, and shortness of breath [6]. A study conducted with 413 (95 males) Estonian medical students found that anxiety levels, measured using an emotional state questionnaire, was associated with sleep quality [8]. For the women in this study, anxiety was significantly associated with having nightmares and feeling tired in the morning, after controlling for other sleep problems and habits in a multiple regression analysis [8]. Another cross-sectional study conducted with 143 (94 males) Taiwanese fifth-year medical students revealed that anxiety, measured using the Beck Anxiety Inventory, was significantly associated with sleep quality as assessed by the ISI [9]. Parkerson et al. [10] reported that adequate sleep has a significant negative association with anxiety in first-year medical students. In this study, preclinical poor sleep was related to higher post-clerkship anxiety, but preclinical chronotype did not predict higher post-clerkship anxiety. A cross-sectional study with young adults reported that chronotype, measured according to their mid-sleep point on free days and corrected for oversleep, was not asso-

ciated with subsyndromal anxiety symptoms [21]. A recent study conducted with adolescents found that evening chronotype did not predict anxiety symptoms after 30 months relative to the baseline, after controlling for gender, anxiety measured at 18 months relative to the baseline, and pubertal status [22]. To our knowledge, no study on the relationship between chronotype and anxiety among medical students has been published.

In this study, preclinical year depressive symptoms predicted the sleep quality at year 4 after controlling for age, sex, and anxiety and chronotype at year 2. A previous cross-sectional study, conducted with 140 medical students, found that sleep quality, measured using the PSQI, was correlated with symptoms of depression, as assessed using the Beck Depression Inventory, with an explanatory power of 15.1%, after controlling for age and sex in a general linear model [11]. When chronotype and distinctness of rhythm (i.e., the subjective ability to adjust individual levels of energy according to the time of the day) were added to the general linear model, the correlation strength increased to 26% [11]. Another study conducted with 413 (77% female) Estonian medical students found that for female students, depression, as measured by an emotional state questionnaire, was associated with several sleep complaints. These complaints included difficulties in going to sleep at night, nightmares, nocturnal hunger, and daytime sleepiness [8]. The same study reported that for male students, depression was associated with poor subjective sleep quality and difficulties in falling asleep at night before tests [8]. Both results were from multiple regression analyses with explanatory powers of 26.0% and 22.1%, respectively [8]. Our results suggest that the preclinical level of subjective depression predicted post-clerkship sleep quality. Sex was not a significant predictor for sleep quality. Another cross-sectional study revealed that sleep

quality as measured by the PSQI was not significantly associated with emotional exhaustion [23].

The limitations of this study include a small sample size, the lack of a control group, and the use of self-reporting questionnaires. Selection bias might have occurred as only students who had not undergone withdrawal from school temporarily during years 2–4 were included. Despite these limitations, this study has several strengths. First, although this study is preliminary, it was conducted with a prospective design. The first assessments were conducted halfway through year 2, and the second assessments were done just after the clinical years. Second, in both multiple linear regression analyses of the clinical meaning of insomnia in medical students, chronotype was included as a confounder. According to our results, insomnia, not chronotype, was a better predictor of future anxiety levels in medical students. Third, to our knowledge, this is the first study to identify depression as a preclinical predictor of post-clerkship insomnia.

In conclusion, this study found that preclinical year insomnia may be related to post-clerkship anxiety. Post-clerkship insomnia was related to preclinical year depression. As insomnia can be reduced by a cognitive behavioral approach more easily than can clinical depression and anxiety, these findings can help medical school administrators with promoting student mental health.

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None

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: So-Jin Lee, Hyoseung Kang, Bong-Jo Kim, Boseok Cha, Dongyun Lee. Data curation: Jiyeong Seo, Jae-Won Choi, Yoon Jung Lee. Formal analysis: So-Jin Lee, Hyoseung Kang, Cheol-Soon Lee. Funding acquisition: So-Jin Lee, Bong-Jo Kim, Cheol-Soon Lee, Boseok Cha. Investigation: all authors. Methodology: So-Jin Lee, Hyoseung Kang, Cheol-Soon Lee, Dongyun Lee. Project administration: all authors. Resources: all authors. Software: So-Jin Lee, Bong-Jo Kim, Cheol-Soon Lee, Boseok Cha. Supervision: So-Jin Lee, Bong-Jo Kim, Cheol-Soon Lee, Boseok Cha. Validation: Cheol-Soon Lee, Dongyun Lee, Jae-Hon Lee. Visualization: all authors. Writing—original draft: So-Jin Lee, Hyoseung Kang, Dongyun Lee. Writing—review & editing: all authors.

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