ORIGINAL ARTICLE

Child Health Nurs Res, Vol.26, No.1, January 2020: 55-63
https://doi.org/10.4094/chnr.2020.26.1.55

ISSN(Print) 2287-9110
ISSN(Online) 2287-9129

CHNR

The Pittsburg Sleep Quality Index (PSQI) and Associated Factors in Middle-school Students: A Cross-sectional Study

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Purpose: The purpose of this study was to evaluate the current level of sleep quality among Korean middle-school students using the Pittsburg Sleep Quality Index (PSQI), and to analyze the factors influencing sleep quality. **Methods:** The study used a descriptive cross-sectional design and a self-report questionnaire. The participants were 744 middle-school students. The questionnaire included the PSQI and health-related questions, such as the types of diseases they had been diagnosed with and the frequency of hospital admissions. The data were analyzed using the independent t-test, analysis of variance, Pearson correlation coefficients, and linear multiple regression. **Results:** The global PSQI score was 4.21, which indicated good sleep quality. The major factors that were associated with the sleep quality of middle-school students were the number of diseases they had been diagnosed with (β=.54, *p*=.001) and atopic dermatitis (β=.32, *p*=.001). In addition, asthma and the frequency of hospital admissions were significant factors influencing each component of the PSQI. **Conclusion:** The findings from this study suggest that sleep quality was associated with several health-related factors. Thus, nurses, school nurses, and nursing researchers may need to assess the health-related factors associated with adolescents' sleep quality as part of efforts to improve their sleep quality.

Key words: Sleep; Sleep hygiene; Adolescents; Disease; Atopic dermatitis

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*This study was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MISP) (No: NRF-2016R1C1B2013649).

Received Oct 14, 2019 **Revised** Dec 17, 2019 **Accepted** Jan 2, 2020

INTRODUCTION

Sleep quality is commonly defined in terms of total sleep time, sleep onset latency, sleep efficiency, degree of fragmentation, or sometimes sleep-disruptive events [1]. Various sleep measures have been developed, the most widely employed of which is the Pittsburgh Sleep Quality Index (PSQI) [2]. The PSQI presents a measure of global sleep quality based on a respondent's retrospective evaluation of sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction [2]. Problems with initiating and maintaining sleep are common among adolescents and are considered to be indicative of poor sleep quality [3].

According to the recommendations of the United States National Sleep Foundation [4], adolescents from 14 to 17 years of age require 8 to 10 hours of sleep per day. Similarly, the Korean Sleep Research Society recommends 9 to 10 hours of sleep for adolescents [5]. However, the average sleep duration of Korean adolescents has been found to be 5.8 to 7.4 hours, with irregular sleep patterns [6]. Sleep patterns often change in adolescence due to school schedules, causing many middle- and high-school students to experience sleep deprivation during the week, and to catch up on sleep on the weekend. For

example, adolescents, on average, reported 6.1 hours of sleep per night on weekdays, but 8.3 hours per night on weekends [7]. In addition, their bedtimes and wake-up times were different on weekdays and weekends, such as 6 AM on weekdays but 9 AM on weekends [7].

Poor sleep quality has important effects on adolescents' health. For example, sleep quality is associated with physical and emotional growth [8], learning and academic performance, and cognitive functions [9]. Middle school and high school require more complex academic tasks, but adolescents with chronic sleep deprivation and short sleep duration may experience poor daytime functioning and academic performance [10]. Thus, current Korean adolescents' sleep duration and quality may need improvement, and the factors that affect sleep quality need to be investigated to improve their sleep quality.

Previous researchers have examined the factors affecting poor and short sleep among adolescents. For example, after-school classes, time for homework, and time relevant to learning were found to be factors influencing sleep duration, but mobile phone and computer use did not have significant relationships with sleep quality [7]. A study revealed that mobile phone addiction affected sleep quality among Korean adolescents, but did not impact sleep duration [11]. Other factors, such as not smoking and feeling healthy, happy, and satisfied with their school lives, were significantly associated with sleep quality among adolescents [8].

In terms of health-related factors and their relationship to sleep quality, many previous studies have focused on adult patients, as exemplified by studies of sleep disturbances after heart surgery [12] or factors affecting sleep quality among adult patients with diabetes [13]. Another study found that the number of comorbid conditions, which was also associated with a high hospital admission rate, affected sleep quality among adults [14]. Some studies have examined health-related factors affecting sleep quality among adolescents, such as physical activity [8] and overweight and obesity [15], as well as the effects of certain diagnoses, such as atopic diseases [16], asthma [17], fatigue, and health-related quality of life [18]. However, the relationships between other health-related factors (e.g., hospital admissions and number of diagnoses) and sleep quality have not been widely investigated among adolescents.

Therefore, this study evaluated the current level of sleep quality among Korean middle-school students using the PSQI, assessed the relationships of sleep quality with health-related factors (e.g., specific diagnosed diseases, number of diagnosed diseases, and the frequency of hospital admissions), and analyzed the key factors influencing sleep quality.

METHODS

1. Study Design and Samples

The researcher used a descriptive, cross-sectional design to analyze data collected from January to March, 2017 as part of research on middle-school students' health [19]. Participants were recruited from two middle schools in Seoul metropolitan area using convenience sampling. Eligible participants were those who (1) currently attended middle school, (2) comprehended the purpose of the study and agreed to participate, and (3) received permission to participate from their parents.

In total, 799 questionnaires were returned, but 55 were excluded due to inadequate data on the PSQI and/or health-related questions; thus, 744 questionnaires were analyzed. Using the G*Power program for a post-hoc analysis using multiple linear regression, the sample size of this study reached a power (1-β) of 95% (calculated effect size of this study [f^2]=.215, α=.05) [20,21].

2. Instruments

1) Sleep quality: Korean version of the Pittsburgh Sleep Quality Index

The sleep quality of middle-school students was measured using the PSQI [2], which was translated into Korean and evaluated for reliability and validity in its Korean form (PSQI-K) [22]. The PSQI-K consists of 19 questions distributed across the following seven components: sleep quality, sleep onset latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. Each item is scored from 0 to 3, and the total scores of the seven components are referred to as the global PSQI score, which ranges from 0 to 21. A global PSQI score over 5 indicates poor sleep relative to clinical and laboratory measures, and higher scores indicate poorer sleep quality. The Cronbach's α of the original PSQI was .83 [2], and that of the PSQI-K was .84 [22]. In this study, it was .85.

2) Participants' characteristics

Participants' characteristics, including sex, grade, frequency of hospital admissions, number of diseases that they had been diagnosed with, asthma, gastrointestinal diseases, scoliosis, atopic dermatitis, and allergies, were surveyed and included as independent variables. Parents were requested to fill out these items together with the participants to ensure data accuracy. The item on frequency of hospital admissions included hospital admissions within the last year. A disease was considered to have been diagnosed if it (1) was a chronic condition, and (2) still affected a participant's current health sta-

tus in a way that required ongoing relevant treatment (e.g., taking any medication or having regular hospital visits due to the diagnosis) during the last 12 months. The number of diseases a participant was diagnosed with included asthma, gastrointestinal diseases, scoliosis, atopic dermatitis, allergies, and any other diseases that met the criteria for diagnosis. The diagnoses analyzed in this study did not include conditions that (1) were acute (i.e., with the disease disappearing in one to two weeks) or (2) did not require any further treatment, such as the common cold or enteritis due to food poisoning.

3. Ethical Considerations

This study was approved by the corresponding author's university Institutional Review Board (IRB) (No. 1041078-2016 11-HRSB-121-01). The survey did not collect any identifiable personal information, and the survey and electronic data were saved in a secured place with password protection. Only the researcher and research assistant hired for this study were able to access the data.

4. Data Collection and Procedure

The researcher visited two middle schools to explain the study and to obtain permission from the schools. After obtaining permission from the school health nurses and principals of the middle schools, posters including information about the study were posted on bulletin boards. A trained research assistant unaffiliated with the schools was assigned to manage the entire process of data collection to ensure the anonymity of participants. The research assistant explained the purpose and process of the study, as well as ethical considerations, and if a student agreed to participate, the research assistant provided the survey packet, which contained detailed information on the study, consent forms for both parents and participants, and a return envelope. Data were collected with a self-report questionnaire completed by students at home, accompanied by their parents to ensure data accuracy. The questionnaire took approximately 15 minutes to complete. After filling out the survey, participants returned the survey packet-including the questionnaire and written consent forms of the participants and their parents-to the research assistant, and then participants were given a small token of appreciation (a stationery set).

5. Data Analysis

The researcher analyzed the collected data using the IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to describe participants' general characteristics and study variables. The independent t-test, one-way analysis of variance, and the Bonferroni post-hoc test were used to analyze differences in global PSQI scores and each PSQI component score according to participants' general characteristics and the types of diseases they had been diagnosed with. Correlations between the frequency of hospital admissions, the number of diseases participants had been diagnosed with, the global PSQI score, and each PSQI component score were all assessed using Pearson correlation coefficients. Linear multiple regression was conducted to identify factors influencing sleep quality among middle-school students. The variables that showed a significant relationship with global PSQI score and/or each PSQI component scores through univariate analysis were included in the linear multiple regression analysis as independent variables. Thus, the independent variables included were grade, asthma, gastrointestinal diseases, atopic dermatitis, the frequency of hospital admissions, and the number of diseases participants had been diagnosed with. The assumptions of linear multiple regression were tested, and generally met, through a residual analysis.

RESULTS

1. Participants' Characteristics and Sleep Quality

Participants' general characteristics are presented in Table 1. The distribution according to sex and grade was almost equal. The mean frequency of hospital admissions was 1.14, and the participants had been diagnosed with an average of 1.51 diseases, of which atopic dermatitis (27.7%) and allergies (10.6%) were the most frequent diagnoses.

Participants' PSQI scores for each component and global PSQI scores are shown in Table 2. The mean global PSQI score was 4.21, which indicates good sleep quality. With regard to each component, daytime dysfunction showed the highest mean score, which indicates that many participants experienced daytime dysfunction. The lowest score was found for use of sleeping medications, indicating that most participants did not use sleeping medications.

2. Differences in Pittsburgh Sleep Quality Index Scores According to Participants' Characteristics and Types of Diseases Diagnosed

Differences in PSQI scores according to participants' general characteristics and the types of diseases they had been diagnosed with are presented in Table 3. Statistically significant differences were found according to grade level and the presence of asthma, gastrointestinal diseases, and atopic dermatitis. First-grade middle-school students had higher scores

Table 1. Characteristics of the Participants (*N*=744)

Characteristics	Categories	n (%) or M±SD
Sex	Male	362 (48.7)
	Female	382 (51.3)
Grade	First	270 (36.3)
	Second	247 (33.2)
	Third	227 (30.5)
Frequency of hospital admissions (in the last 12 months)		1.14±0.40 (range 0~3)
Number of diseases diagnosed (receiving relevant treatment in the last 12 months)		1.51±0.77 (range 0~4)
Asthma	No	719 (96.6)
	Yes	25 (3.4)
Gastrointestinal diseases	No	735 (98.8)
	Yes	9 (1.2)
Scoliosis	No	709 (95.3)
	Yes	35 (4.7)
Atopic dermatitis	No	538 (72.3)
	Yes	206 (27.7)
Allergies (including food)	No	665 (89.4)
	Yes	79 (10.6)

Table 2. Descriptive Statistics of Pittsburgh Sleep Quality Index Scores (*N*=744)

Categories	M±SD	Min~Max
Global PSQI score (total score)	4.21±2.43	0~13
Comp. 1: subjective sleep quality	0.89±0.58	0~3
Comp. 2: sleep latency	0.99±1.09	0~3
Comp. 3: sleep duration	0.28±0.61	0~3
Comp. 4: habitual sleep efficiency	0.07±2.94	0~3
Comp. 5: sleep disturbances	0.68±0.55	0~3
Comp. 6: use of sleeping medications	0.01±0.14	0~2
Comp. 7: daytime dysfunction	1.28±0.90	0~3

PSQI=Pittsburgh Sleep Quality Index; Comp.=Component.

for subjective sleep quality (component 1; p=.019) and sleep duration (component 3; p=.001), which means that they had worse subjective sleep quality and shorter sleep duration than their counterparts in other grades. Participants with asthma (global PSQI; p=.023) and gastrointestinal diseases (global PSQI; p=.044) had overall worse sleep quality than students who did not suffer from these ailments. Participants who had atopic dermatitis had shorter sleep duration (component 3; p=.047).

3. Correlations between Frequency of Hospital Admissions, Number of Diseases Diagnosed, and Pittsburgh Sleep Quality Index Scores

The number of diseases that participants had been diagnosed with was positively correlated with the global PSQI score and each PSQI component score (r=.09~.34, p<.050), which means that participants with more diseases had worse sleep quality (Table 4). The frequency of hospital admissions was also positively correlated with sleep disturbances (r=.07, p=.046) and use of sleep medications (r=.13, p=.001).

4. Factors Associated with Pittsburgh Sleep Quality Index Scores

Before conducting linear multiple regression, the researcher evaluated collinearity among the independent variables (e.g., grade, asthma, gastrointestinal disease, atopic dermatitis, the frequency of hospital admissions, and the number of diseases that participants had been diagnosed with). The ranges of tolerance and the variation inflation factor (VIF) were 0.60~0.98 (evaluation criterion: > 0.1) and 1.01~1.64 (evaluation criteria: <10), respectively. Thus, multicollinearity was not found among the independent variables. To evaluate whether the assumption of independent errors was met, the Durbin-Watson statistic was calculated for the eight regression models, with values ranging from 1.99 to 2.04 (evaluation criterion: close to 2 or between 1 and 3).

To identify the major factors affecting sleep quality, linear multiple regression was conducted using the stepwise method with the global PSQI score and the seven PSQI component scores as dependent variables (Table 5). The results showed that the model predicting the global PSQI score was significant (F=39.38, p<.001), with an adjusted R^2 of .172, indicating that the model explained 17.2% of the variance in global PSQI scores. In this model, the number of diseases that participants had been diagnosed with (β=.54, p=.001) and atopic dermatitis (β=.32, p=.001) were significant factors affecting sleep quality among middle-school students.

Low subjective sleep quality was associated with the number of diseases that participants had been diagnosed with (β=.31, p=.001) and atopic dermatitis (β=.19, p=.001). Poor sleep latency was associated with the number of diseases that participants had been diagnosed with (β=.32, p=.001), atopic dermatitis (β=.20, p=.001), and asthma (β=.09, p=.027). Shorter sleep duration was associated with the number of diseases that participants had been diagnosed with (β=.36, p=.001), being a second- or third-grade student (β=-.20, p=.001, and β=-.16, p=.001, respectively), atopic dermatitis (β=.15, p=.001), and the frequency of hospital admissions (β=.09, p=.014). Lower habit-

Table 3. Differences in Pittsburgh Sleep Quality Index Scores According to Participants' General Characteristics and the Types of Diseases Diagnosed (*N*=744)

Variables	Categories	n	Global PSQI	Comp. 1	Comp. 2	Comp. 3	Comp. 4	Comp. 5	Comp. 6	Comp. 7
			M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Sex	Male	362	4.13 (2.39)	0.90 (0.57)	0.99 (1.09)	0.26 (0.58)	0.07 (0.28)	0.65 (0.55)	0.02 (0.16)	1.23 (0.91)
	Female	382	4.28 (2.46)	0.88 (0.58)	0.99 (1.09)	0.30 (0.64)	0.07 (0.29)	0.70 (0.55)	0.01 (0.11)	1.33 (0.88)
	*p**		.391	.579	.977	.365	.945	.250	.737	.139
Grade	First[a]	270	4.42 (2.65)	0.97 (0.56)	1.00 (1.10)	0.44 (0.75)	0.08 (0.30)	0.65 (0.57)	0.01 (0.08)	1.28 (0.93)
	Second[b]	247	4.09 (2.30)	0.83 (0.62)	0.89 (1.09)	0.22 (0.53)	0.05 (0.27)	0.71 (0.55)	0.02 (0.17)	1.34 (0.88)
	Third[c]	227	4.07 (2.27)	0.85 (0.53)	1.09 (1.09)	0.15 (0.45)	0.09 (0.29)	0.67 (0.54)	0.01 (0.14)	1.21 (0.88)
	p†		.186	.019 a > b‡	.145	.001 a > b, c‡	.395	.503	.391	.255
Asthma	No	719	4.16 (2.38)	0.88 (0.57)	0.99 (1.10)	0.27 (0.60)	0.07 (0.28)	0.67 (0.55)	0.02 (0.14)	1.25 (0.88)
	Yes	25	5.28 (3.10)	1.00 (0.70)	1.00 (1.00)	0.48 (0.91)	0.16 (0.47)	0.72 (0.54)	0.01 (0.01)	0.92 (0.99)
	*p**		.023	.321	.965	.096	.131	.676	.595	.001
Gastrointestinal diseases	No	735	4.19 (2.40)	0.89 (0.57)	0.99 (1.10)	0.27 (0.59)	0.07 (0.28)	0.68 (0.55)	0.01 (0.14)	1.27 (0.89)
	Yes	9	5.56 (4.06)	1.00 (0.70)	1.11 (0.92)	0.89 (1.26)	0.22 (0.66)	0.67 (0.50)	0.07 (0.01)	1.67 (1.22)
	*p**		.044	.562	.746	.003	.124	.959	.004	.195
Scoliosis	No	709	4.20 (2.40)	0.88 (0.57)	1.00 (1.10)	0.27 (0.60)	0.07 (0.29)	0.68 (0.55)	0.01 (0.14)	1.28 (0.90)
	Yes	35	4.34 (2.92)	0.97 (0.66)	0.86 (1.03)	0.43 (0.81)	0.09 (0.28)	0.63 (0.59)	0.03 (0.16)	1.34 (0.93)
	*p**		.731	.385	.453	.141	.790	.613	.556	.668
Atopic dermatitis	No	538	4.18 (2.42)	0.89 (0.58)	1.00 (1.10)	0.25 (0.57)	0.07 (0.29)	0.68 (0.56)	0.01 (0.13)	1.27 (0.89)
	Yes	206	4.27 (2.46)	0.89 (0.57)	0.98 (1.08)	0.34 (0.69)	0.07 (0.29)	0.67 (0.54)	0.01 (0.15)	1.30 (0.91)
	*p**		.660	.989	.771	.047	.978	.825	.984	.657
Allergies (including food)	No	665	4.18 (2.42)	0.89 (0.58)	0.99 (1.09)	0.27 (0.60)	0.07 (0.28)	0.68 (0.55)	0.01 (0.12)	1.26 (0.89)
	Yes	79	4.47 (2.50)	0.87 (0.56)	1.05 (1.10)	0.33 (0.69)	0.10 (0.34)	0.67 (0.57)	0.03 (0.22)	1.42 (0.96)
	*p**		.306	.793	.638	.400	.345	.869	.476	.136

*t-test; †Analysis of variance; ‡Bonferroni post-hoc test; PSQI=Pittsburg Sleep Quality Index; Comp. 1=Subjective sleep quality; Comp. 2=Sleep latency; Comp. 3=Sleep duration; Comp. 4=Habitual sleep efficiency; Comp. 5=Sleep disturbances; Comp. 6=Use of sleeping medications; Comp. 7=Daytime dysfunction.

Table 4. Correlations of the Frequency of Hospital Admission and the Number of Diseases Diagnosed with Pittsburgh Sleep Quality Index Scores

Variables	Global PSQI	Comp. 1	Comp. 2	Comp. 3	Comp. 4	Comp. 5	Comp. 6	Comp. 7
	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)	r (*p*)
Frequency of hospital admissions	.02 (.551)	.03 (.449)	.01 (.991)	.05 (.208)	.04 (.290)	.07 (.046)	.13 (.001)	.01 (.883)
Number of diseases diagnosed	.34 (.001)	.18 (.001)	.18 (.001)	.25 (.001)	.22 (.001)	.13 (.001)	.09 (.016)	.23 (.001)

PSQI=Pittsburg Sleep Quality Index; Comp. 1=Subjective sleep quality; Comp. 2=Sleep latency; Comp. 3=Sleep duration; Comp. 4=Habitual sleep efficiency; Comp. 5=Sleep disturbances; Comp. 6=Use of sleeping medications; Comp. 7=Daytime dysfunction.

ual sleep efficiency was associated with the number of diseases that participants had been diagnosed with (β=.35, *p*=.001) and atopic dermatitis (β=.21, *p*=.001). Worse sleep disturbances were associated with the number of diseases that participants had been diagnosed with (β=.23, *p*=.001) and atopic dermatitis (β=.15, *p*=.001). Higher use of sleeping medications was associated with frequency of hospital admissions (β=.13, *p*=.001). Finally, higher daytime dysfunction was associated with the number of diseases that participants had been diagnosed with (β=.35, *p*=.001) and atopic dermatitis (β=.20, *p*=.001).

DISCUSSION

This study was conducted to explore the current level of sleep quality among middle-school students using the PSQI-K. This study also analyzed the factors that contributed to the students' PSQI scores, and found that students' global PSQI scores and individual PSQI component scores indicated satisfactory sleep levels, as a global PSQI score over 5 indicates poor sleep quality relative to clinical and laboratory measures [2].

Table 5. Factors Associated with Pittsburgh Sleep Quality Index Scores among Middle-school Students

Variables	Categories	B	SE	β	t (*p*)
Predicting the global PSQI score	Number of diseases diagnosed	1.38	0.11	.54	12.50 (.001)
	Atopic dermatitis	1.71	0.23	.32	7.44 (.001)
		F=39.38, $p<.001$, R^2=.177, Adjusted R^2=.172			
Predicting comp. 1: subjective sleep quality	Number of diseases diagnosed	0.19	0.03	.31	6.72 (.001)
	Atopic dermatitis	0.25	0.06	.19	4.24 (.001)
		F=16.03, $p<.001$, R^2=.061, Adjusted R^2=.058			
Predicting comp. 2: sleep latency	Number of diseases diagnosed	0.38	0.06	.32	6.82 (.001)
	Atopic dermatitis	0.50	0.11	.20	4.55 (.001)
	Asthma	0.52	0.23	.09	2.22 (.027)
		F=15.61, $p<.001$, R^2=.060, Adjusted R^2=.056			
Predicting comp. 3: sleep duration	Number of diseases diagnosed	0.24	0.03	.36	8.25 (.001)
	Grade: third *	-0.27	0.05	-.20	5.18 (.001)
	Grade: second*	-0.21	0.05	-.16	4.08 (.001)
	Atopic dermatitis	0.20	0.06	.15	3.39 (.001)
	Frequency of hospital admissions	0.14	0.06	.09	2.46 (.014)
		F=21.40, $p<.001$, R^2=.128, Adjusted R^2=.122			
Predicting comp. 4: habitual sleep efficiency	Number of diseases diagnosed	0.11	0.01	.35	7.86 (.001)
	Atopic dermatitis	0.14	0.03	.21	4.65 (.001)
		F=30.87, $p<.001$, R^2=.077, Adjusted R^2=.075			
Predicting comp. 5: sleep disturbances	Number of diseases diagnosed	0.13	0.03	.23	4.95 (.001)
	Atopic dermatitis	0.19	0.06	.15	3.29 (.001)
		F=8.99, $p<.001$, R^2=.035, Adjusted R^2=.031			
Predicting comp. 6: use of sleeping medications	Frequency of hospital admissions	0.05	0.01	.13	3.66 (.001)
		F=13.42, $p<.001$, R^2=.018, Adjusted R^2=.017			
Predicting comp. 7: daytime dysfunction	Number of diseases diagnosed	0.33	0.04	.35	7.80 (.001)
	Atopic dermatitis	0.39	0.09	.20	4.42 (.001)
		F=21.41, $p<.001$, R^2=.080, Adjusted R^2=.077			

*Reference category: first; PSQI=Pittsburg Sleep Quality Index; Comp.=Component.

The key factors associated with sleep quality among middle students were the number of diseases that they had been diagnosed with and a diagnosis of atopic dermatitis. Previous studies revealed that the global PSQI score significantly increased as the number of comorbid conditions increased ($p<.001$) in a linear regression analysis [14]. Similarly, the results of this study also suggest that the global PSQI score and each component score (components 1, 2, 3, 4, 5, and 7) significantly increased as the number of diseases that participants had been diagnosed with increased. However, the participants of the previous study were middle-aged adults (mean age: 51.0 years), whereas this study included only adolescents. Apart from the previous study, limited research has been conducted on the association between sleep quality and number of diseases among adolescents. Therefore, to the best of our knowledge, this is the first study to identify an association between PSQI scores and the number of diseases that adolescents had been diagnosed with.

In this study, 27.7% of the participants had atopic dermatitis, which was found to be a significant factor associated with sleep quality. The prevalence of atopic dermatitis among children and adolescents in Korea steadily increased from 1995 (7.3%) to 2015 (20.0%) according to the International Study of Asthma and Allergies in Childhood epidemiological study, which utilized nationwide big data, and a cohort study on allergic diseases [2,23]. According to the 2018 Korean Youth Risk Behavior Survey (KYRBS) [24], atopic dermatitis among middle-school students increased by grade, with a prevalence of 20.0% in first-grade students and 24.9% in third-grade students. Thus, the participants in this study had a higher prevalence of atopic dermatitis than the national average. In contrast, the prevalence of allergies among the participants of

the present study (regardless of type, including food allergies) was found to be lower than the national average prevalence of allergic rhinitis among middle-school students. For example, 10.6% of the participants had allergies, whereas 31.7% of middle-school students reported allergic rhinitis in the KYRBS [24].

Several studies have investigated sleep quality in patients with atopic dermatitis, and reported similar results to this study. For example, Kong, Han, Lee, and Son [25] found that the severity of atopic dermatitis (assessed using the scoring atopic dermatitis scale) and sleep quality (assessed using the children's sleep habits questionnaire) demonstrated significant correlations. Recently, a longitudinal cohort study also found that total sleep duration was similar between children with and without atopic dermatitis; however, children with atopic dermatitis had significantly worse sleep quality from 1 to 16 years of age [26].

Interestingly, use of sleeping medications (component 6) was significantly and positively associated with the frequency of hospital admissions. Although this model explained only 1.7% of the variance in PSQI component 6, participants who had been admitted to the hospital may have been prescribed sleep medications due to their symptoms or sleep disturbances during hospital admission. Unfortunately, limited research has explored associations between use of sleep medication and the frequency of hospital admission among adolescents. However, significant associations were found between sleep quality and sleep disturbances among adult inpatients [27]. Therefore, more research into these associations is required in this younger population.

In this study, asthma was associated with poor sleep latency (component 2) among middle-school students. Polysomnographic recordings comparing sleep disturbances in asthmatic and non-asthmatic children and adolescents [28] revealed that sleep latency was significantly longer in asthmatic children than in non-asthmatic children. Jensen et al. [28] found that male asthmatic children had a significantly shorter sleep duration than their male non-asthmatic counterparts, whereas sleep duration (component 3) did not show a significant association with asthma in this study. Previous studies also supported the association of asthma and sleep quality in adolescents and young adults [17]. Garden et al. [17] found that poor sleep quality was associated with asthma in individuals between 14 and 21 years of age, with stronger associations among females. In addition, associations were mediated by asthma symptom severity. Another study conducted among adolescents with persistent asthma [29] revealed that better sleep hygiene was significantly related to higher sleep quality, quality of life in terms of health, and better sustained attention. Sleep hygiene is defined as a variety of different practices and habits that promote good sleep quality [2], such as sleep environment, sleep routine, and daytime activities [30]. Sleep hygiene and sleep quality may be associated with adolescents' health conditions, as well as their academic achievement; therefore, further studies on these correlations among adolescents with diagnoses other than asthma are recommended.

The results of this study should be interpreted with some caution given its limitations. First, this was a cross-sectional self-report survey, so it is difficult to evaluate the causal relationships between independent variables and PSQI scores. In addition, other factors not surveyed in this study may affect sleep quality among adolescents. An additional longitudinal study including other factors affecting sleep quality among adolescents is recommended to determine the directionality of relationships among the variables more clearly. Second, the researcher recruited samples from two middle schools in a single nation, and employed convenience sampling. Thus, the findings from this study might have limited generalizability. Third, the questionnaire only asked about the frequency of admissions and the total number of diagnoses, but did not survey the reason for each admission or the entire list of diagnoses. The severity of a diagnosis and the reason for admission may affect quality of sleep. Finally, considering that this study surveyed participants' diseases, some students with more serious diagnoses and their parents might not have wanted to participate. If that was the case, the PSQI scores could have been biased towards better sleep quality. Nevertheless, despite these limitations, this study provides important fundamental information on sleep quality and associated health-related factors among middle-school students.

CONCLUSION

Sleep quality among adolescents is important because it may affect their academic achievement and other daily functions. The findings from this study indicate that several health-related factors can affect the sleep quality of adolescents, such as the number of diseases diagnosed, the frequency of hospital admissions, atopic dermatitis, and asthma. The influence of some medical conditions on sleep quality have been well studied, but that of other conditions has not sufficiently been investigated. Therefore, various factors that may affect sleep quality among adolescents should be examined. Since sleep deprivation in adolescents is a global trend [17,18], more research on health-related factors affecting sleep between countries and ethnic groups is needed. The nursing implication of this study is that nursing professionals need to assess atopic dermatitis and asthma, which were found to be health-related factors associated with adolescents' sleep quality in this study. In addition, school nurses and nursing re-

searchers could design interventions to improve middle-school students' health conditions to boost their sleep quality.

Conflict of interest

No existing or potential conflict of interest relevant to this article was reported.

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