NEW RESEARCH

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The Association between Sleep Duration and Self-Rated Health in the Korean General Population

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SCIENTIFIC INVESTIGATIONS

Study Objectives: Sleep duration is recognized as one of the most common issues in modern society. Self-rated health is a commonly used subjective health measure based on a single question asking individuals to rate their general health on a four- or five-point scale. However, few studies have examined the relationship between sleep duration and self-rated health. Here, we examined the association between sleep duration and poor self-rated health, using a large representative sample of the general Korean adult population.

Design: We conducted a cross-sectional study of 15,252 participants in the Korea National Health and Nutrition Examination Survey IV (2007-2009) who were aged 19 years and older. Sleep duration was categorized as ≤ 5, 6, 7, 8, or ≥ 9 hours. The main outcome of interest was poor self-rated health (n = 3,705, 19.7%). Multiple logistic regression analysis was performed to examine the association between sleep duration and self-rated health.

Results: We found both short (≤ 5 h) and long (≥ 9 h) sleep duration to be associated with poor self-rated health independent of sociodemographic, health risk, and health status variables. Compared with 7-h sleep duration, the multivariate odds of poor self-rated health were 1.358 times higher (95% CI 1.167-1.580) with short sleep duration and 1.322 times higher (95% CI 1.091-1.601) with long sleep duration. This association persisted in subgroup analyses of gender, body mass index, and age by gender.

Conclusions: In a large representative sample of the Korean general adult population, compared with sleep duration of 7 hours, we found a positive association between short and long sleep duration and poor self-rated health in Korean adults. Furthermore, the association between sleep duration and poor self-rated health was consistently present in subgroups divided by gender, age, and BMI.

Keywords: Sleep, sleep duration, self-rated health, gender, age, body mass index (BMI), KNHANES

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Disorders of sleep duration, such as sleep loss, sleep deprivation, and insufficient sleep are recognized as common issues in modern society and are pervasive in developed countries.[1] In recent years, a number of studies have indicated that sleep duration may be an important indicator of one's perceived health status.[2-13] Several studies also indicate that disorders of sleep duration hamper both perceived physical and mental health[4,5,9,14-16] and report that perceived health risks in individuals with sleep durations are somewhat greater than those in individuals with chronic physical illness.[8,10] Moreover, both short and long sleep duration are associated with elevated risk of diabetes mellitus, hypertension, and cardiovascular disease (CVD).[15,17-20] Chronic health conditions such as diabetes mellitus,[21] mental health conditions, and short sleep duration[22] are strong predictors of self-rated health.[23,24] Insufficient sleep duration is linked to elevated body mass index,[25] weight gain,[26] and obesity.[27] Gender differences in health perceptions are often reported, as women may consider more factors than men when rating their health.[28,29] Physical activity and socioeconomic status may also be important determinants of perceived health,[30] with higher socioeconomic status protective against poor self-rated health.[31]

BRIEF SUMMARY

Current Knowledge/Study Rationale: Sleep durations are important from the viewpoint of health management. Both short and long sleep duration are known to affect poor self-rated health in Korea.

Study Impact: In adults, both short and long sleep duration are known to be associated with a variety of negative outcomes and inappropriate sleep duration is a poor self-rated health in Korean general population.

Self-rated health is a subjective measure of health that is commonly used in epidemiological studies to examine changes in health status.[32,33] The measure is based on a simple question asking individuals to rate their general health on a 4- or 5-point scale. Due to its ability to predict future risk of objective health outcomes, an Institute of Medicine report in 2001 recommended the inclusion of self-rated health measurement in national surveys in the USA as a way of tracking subjective health status of Americans.[34] Although self-rated health tends to reflect higher than actual health status,[35] it provides a convenient and inexpensive method of assessing individual health and provides an important and valid indicator of individual health status and associated health outcomes.[36] To the best of our knowledge, relatively few studies have examined this topic. Here, we

examined the association between sleep duration and poor self-rated health using a large representative sample of the general Korean adult population after adjusting for confounding factors such as measures of socioeconomic status (age, gender, household income level, marital status, occupation, and residential region) and measures of health risk behavior and status (major depression diagnosed by doctor, smoking, alcohol intake, body mass index [BMI], number of days of walking per week, and number of chronic diseases).

METHODS

Study Sample

The Fourth Korea National Health and Nutrition Examination Survey (KNHANES) data set was used to examine the relationship between sleep duration and self-rated health. The survey was conducted by the Korea Ministry of Health and Welfare and had three components: a health interview survey, a health examination survey, and a nutrition survey. The survey was approved by the Institutional Review Board of the Korea Centers for Disease Control and Prevention.

The survey target population was all non-institutionalized South Korean civilian individuals aged 1 year or older. KNHANES surveys have been conducted periodically between 1998 and 2005 and annually since 2007. The fourth KNHANES was conducted for 3 years (2007-2009) and employed stratified, multistage probability sampling units that were based on geographic area, gender, and age, which were determined by the household registries of the 2005 National Census Registry. The survey was carried out through all 12 months of the years except for 2007, when it was implemented for only 6 months (July to December). Thus, the 2007 data were assigned half of the integrated weighted value reflection ratio when combined with data from the other years (2008-2009) to improve statistical power. The total target population consisted of 31,705 people aged ≥ 1 year (6,455 in 2007, 12,528 in 2008, and 12,722 in 2009), of whom 24,871 people (4,594 in 2007, 9,744 in 2008, and 10,533 in 2009) completed the survey. The average response rate was 78.4% (71.2% in 2007, 77.8% in 2008, and 82.8% in 2009). We excluded information from 6,465 individuals aged 1-18 years and included information from 18,406 individuals (total response rate: 74.0%) aged 19 years and older. We further excluded 3,057 individuals without information on age, education, occupation, income, marriage, or residential region; 31 individuals without information on smoking, alcohol consumption, or walking; and 66 individuals without information on sleep duration, suicidal ideation, restriction of activity, depression, self-rated health status, BMI, or chronic illnesses. Thus, a total of 15,252 individuals were selected for this analysis, which accounts for 82.3% of the 18,406 adult responders. As KNHANES data are released to the public for scientific use, ethical approval was not needed for this study.

Chi-square tests and multiple logistic regression analysis were used to analyze whether general characteristics, health status, and health risk behaviors were related to self-rated health. We further performed subgroup analyses by gender, BMI, and age by gender. Statistical analysis software SAS Version 9.2 (SAS Institute, Inc., Cary, NC) was used for data analysis.

Variables

Independent Variable

Sleep duration was assessed by self-reported responses to the question: "How many hours do you usually sleep?" Responses were assigned to 1 of 5 subcategories: ≤ 5 h, 6 h, 7 h, 8 h, and ≥ 9 h. We used the International Classification of Sleep Disorders definition of "short sleep" as ≤ 5 h and "long sleep" as ≥ 9 h.[37]

Dependent Variable

Perceived physical health status was assessed with the question: "How do you usually perceive your health?" The response "insufficient" or "very insufficient" indicated "Bad," and the response "normal," "sufficient," or "very sufficient" indicated "Good,"[38] thus dichotomizing the response for multiple logistic analysis.

Covariates

Sociodemographic Factors

Age, household income, residency region, occupation, and marital status were included in the analysis as sociodemographic factors. The age variable was divided into 3 groups based on a previous study[22]: 39 years or younger, 40-59 years, and 60 years or older. Household income was calculated by dividing household monthly income by the square root of the number of persons in the household.[39-43] Survey subjects were ranked from lowest to highest incomes and grouped into 4 household income quartiles. Education level was categorized into 4 groups: elementary school or lower, middle school, high school, and college or higher. Residency regions were categorized into Urban (within city boundaries: Seoul, Daejeon, Daegu, Busan, Incheon, Kwangju, or Ulsan) and Rural (not within city boundaries). Occupational status was divided into 3 categories: white collar (administrative, engineering, scientific, teaching and related occupations, sales and related occupations, and service), blue collar (farming, forestry, fishing, hunting, craft and repair, operators, fabricators, and laborers), and unemployed (including housewife and student).

Health Behavior Factors

Questions about alcohol use, smoking status, and walking days per week were assessed by the health interview survey and included as covariates in our analyses. Alcohol use was further assessed by questions about the average frequency (days per week or month) of alcohol consumption during the last year.

Health Status Factors

The number of chronic diseases, BMI, and major depression diagnosed by doctor were also included in the model. The "number of chronic disease(s)" variable included conditions such as high blood pressure, diabetes (including types 1 and 2), stroke, myocardial infarction, and angina. BMI was categorized into 4 groups for the current analysis: thin (< 18.5 kg/m^2), moderate (18.5 kg/m^2 to 23.9 kg/m^2), overweight (24.0 kg/m^2 to 26.9 kg/m^2), and obese (> 27.0 kg/m^2).[44] The number of chronic diseases was operationalized into 2 categories based on how many were present: 0 versus ≥ 1. Major depression[45] was categorized according to a "yes" or "no" response to the

Table 1—Characteristics of the study population by sleep duration

			Sleep duration (h)										
	Total	**%***	**≤ 5**	**%***	**6**	**%***	**7**	**%***	**8**	**%***	**≥ 9**	**%***	**p-value**
Age													< 0.0001
≤ 39	5,160	42.9	411	8.7	1,287	25.9	1,623	30.8	1,369	25.6	470	8.9	
≤ 59	5,709	40.5	748	12.7	1,649	29.7	1,758	30.7	1,218	21.3	336	5.6	
≥ 60	4,383	16.7	1,161	26.7	917	21.7	996	22.2	834	19.5	475	9.9	
Gender													< 0.0001
Male	6,646	52.4	875	11.7	1,845	28.6	1,926	30.1	1,482	22.9	518	6.7	
Female	8,606	47.6	1,445	15.0	2,008	24.7	2,451	28.5	1,939	22.9	763	8.9	
Household income level													< 0.0001
Low	3,172	15.4	774	22.1	649	21.3	750	23.8	647	22.1	352	10.7	
Lower middle	3,799	24.9	647	14.6	956	27.5	1,020	26.9	837	22.8	339	8.3	
Upper middle	4,102	29.1	473	10.8	1,091	26.9	1,236	30.6	982	24.3	320	7.5	
High	4,179	30.5	426	10.2	1,157	28.8	1,371	33.0	955	22.0	270	6.0	
Marital status													< 0.0001
Married	10,989	69.7	1,525	12.5	2,831	27.2	3,292	30.7	2,481	22.7	860	6.9	
Single	2,096	19.8	187	9.5	537	26.1	609	28.1	539	25.8	224	10.5	
Separated	2,167	10.6	608	26.0	485	25.1	476	22.4	401	18.8	197	7.7	
Occupation													
White-collar	5,059	41.1	550	10.7	1,493	30.1	1,678	32.2	1,085	21.9	253	5.0	< 0.0001
Blue-collar	4,560	28.7	758	14.8	1,162	27.4	1,249	28.4	1,032	22.6	359	6.7	
Unemployed	5,633	30.2	1,012	15.4	1,198	21.6	1,450	26.2	1,304	24.4	669	12.4	
Residential region													< 0.0001
Urban	9,604	70.2	1,438	13.5	2,603	28.2	2,816	29.3	2,041	22.1	706	6.9	
Rural	5,648	29.8	882	12.8	1,250	23.3	1,561	29.5	1,380	24.8	575	9.7	
Self-rated health													< 0.0001
Poor	3,705	19.7	861	19.9	827	24.1	868	25.5	747	20.4	402	10.1	
Good	11,547	80.3	1,459	11.7	3,026	27.4	3,509	30.3	2,674	23.5	879	7.1	
Major depression diagnosed by doctor													< 0.0001
Yes	550	2.8	169	26.8	105	22.1	109	20.2	118	21.7	49	9.2	
None	14,702	97.2	2,151	12.9	3,748	26.9	4,268	29.6	3,303	22.9	1,232	7.7	
Smoking status													0.008
Never smoked	8,789	50.8	1,419	14.6	2,140	25.9	2,563	29.3	1,939	22.6	728	7.7	
Former smoker	2,969	20.6	441	12.6	761	26.6	836	30.7	658	22.1	273	8.0	
Current smoker	3,494	28.6	460	11.6	952	28.5	978	28.4	824	24.0	280	7.5	
Frequency of alcohol use													< 0.0001
Never drink	4,405	22.7	901	18.5	1,013	24.8	1,142	26.9	919	21.4	430	8.4	
1-4 times per month	7,460	52.6	922	11.3	1,934	27.0	2,269	30.3	1,748	23.7	587	7.7	
2-3 times or more per week	3,387	24.7	497	12.7	906	28.1	966	29.5	754	22.5	264	7.1	
BMI													< 0.0001
Thin	781	5.2	103	9.8	162	21.1	218	29.4	196	27.4	102	12.3	
Moderate	7,865	51.3	1,115	12.5	1,962	26.3	2,292	29.5	1,825	23.7	671	8.0	
Overweight	4,427	29.4	726	14.6	1,153	27.6	1,259	29.5	956	22.0	333	6.3	
Obese	2,179	14.1	376	14.9	576	28.8	608	28.4	444	20.1	175	7.8	
Number of days of walking per week													< 0.0001
None	1,989	12.2	375	17.2	429	23.4	543	27.4	449	24.3	193	7.7	
1-2	2,329	16.2	275	10.2	562	25.8	714	31.4	585	25.0	193	7.6	
3-4	2,722	18.1	367	11.4	690	26.5	762	28.3	644	23.6	259	10.2	
5-6	2,064	14.2	244	11.0	554	29.1	690	33.0	452	21.3	124	5.6	
Everyday	6,148	39.2	1,059	15.1	1,618	27.5	1,668	28.3	1,291	21.8	512	7.4	
Number of chronic diseases**													< 0.0001
0	11,500	80.9	1,487	11.9	3,000	27.2	3,428	30.0	2,668	23.4	917	7.5	
≥ 1	3,752	19.1	833	19.5	853	24.9	949	26.4	753	20.7	364	8.6	

*Weighted %. **Chronic diseases are hypertension, diabetes mellitus, stroke, myocardial infarction, angina, and arthritis.

Table 2—Association between poor self-reported health and sleep duration*

	Odds ratio	95% CI
Age (years)		
≤ 39	1.000	
≤ 59	1.365	1.187-1.568
≥ 60	1.720	1.447-2.046
Gender		
Male	1.000	
Female	1.879	1.589-2.221
Household income level		
Low	1.738	1.458-2.072
Lower middle	1.326	1.115-1.576
Upper middle	1.125	0.955-1.326
High	1.000	
Marital status		
Married	1.000	
Single	1.094	0.904-1.324
Separated	1.158	1.010-1.326
Occupation		
White-collar	1.000	
Blue-collar	1.082	0.925-1.264
Unemployed	1.334	1.150-1.547
Residential region		
Urban	1.198	1.051-1.366
Rural	1.000	
Major depression diagnosed by doctor		
Yes	2.935	2.309-3.729
None	1.000	
Smoking status		
Never smoked	1.000	
Former smoker	1.207	1.010-1.443
Current smoker	1.546	1.287-1.856
Frequency of alcohol use		
Never drink	1.000	
1-4 times per month	0.756	0.673-0.850
2-3 times or more per week	0.821	0.703-0.959
Sleep duration (h)		
≤ 5	1.358	1.167-1.580
6	1.029	0.906-1.168
7	1.000	
8	0.960	0.829-1.113
≥ 9	1.322	1.091-1.601
BMI		
Thin	1.510	1.213-1.881
Moderate	1.000	
Overweight	0.978	0.872-1.096
Obese	1.222	1.044-1.430
Number of days of walking per week		
None	1.105	0.932-1.310
1-2	1.022	0.876-1.193
3-4	0.903	0.778-1.047
5-6	0.858	0.724-1.017
Everyday	1.000	
Number of chronic diseases**		
0	1.000	
≥ 1	2.234	1.986-2.513

*Adjusted for age, gender, household income level, marital status, occupation, residential region, major depression diagnosed by doctor, smoking status, frequency of alcohol use, sleep duration, BMI, number of days of walking per week, number of chronic diseases. **Chronic diseases are hypertension, diabetes, stroke, myocardial infarction, angina, and arthritis.

question: "Have you ever been diagnosed with major depression by a doctor?"

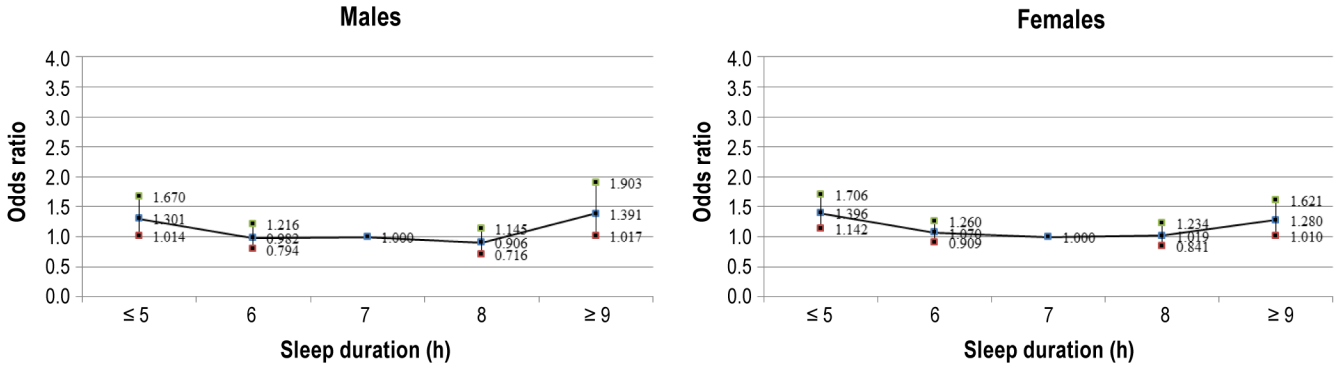
RESULTS

Table 1 presents characteristics of the study population. Of the 15,252 participants included in our study, there were 6,646 (52.4%) males and 8,606 (47.6%) females. Of the males, 875 (11.7%) reported short sleep duration and 518 (6.7%) reported long sleep duration. Of the females, 1,445 (15.0%) reported short sleep duration and 763 (8.9%) reported long sleep duration. There were 5,160 (42.9%) participants aged 19-39 years, 5,709 (40.5%) aged 40-59 years, and 4,383 (16.7%) aged ≥ 60 years. In the 19- to 39-year-old group, 411 (8.7%) reported short sleep duration and 470 (8.9%) reported long sleep duration. In the 40- to 59-year-old group, 748 (12.7%) reported short sleep duration and 336 (5.6%) reported long sleep duration. In the group aged ≥ 60 years, 1,161 (26.7%) reported short sleep duration and 475 (9.9%) reported short sleep duration.

There were 3,705 (19.7%) participants with poor self-rated health and 11,547 (80.3%) with good self-rated health. Among participants with good self-rated health, 1,459 (11.7%) had short sleep duration and 879 (7.1%) had long sleep duration. Among participants with poor self-rated health, 861 (19.9%) had short sleep duration and 402 (10.1%) had long sleep duration. There were 781 (4.8%) thin participants, 7,865 (51.3%) moderate weight participants, 4,427 (29.4%) overweight participants, and 2,179 (14.1%) obese participants. In the thin group, 103 (9.8%) had short sleep duration and 102 (12.3%) had long sleep duration. In the moderate weight group, 1,115 (12.5%) had short sleep duration and 671 (8.0%) had long sleep duration. In the overweight group, 726 (14.6%) had short sleep duration and 333 (6.3%) had long sleep duration. In the obese group, 376 (14.9%) had short sleep duration and 175 (7.8%) had long sleep duration.

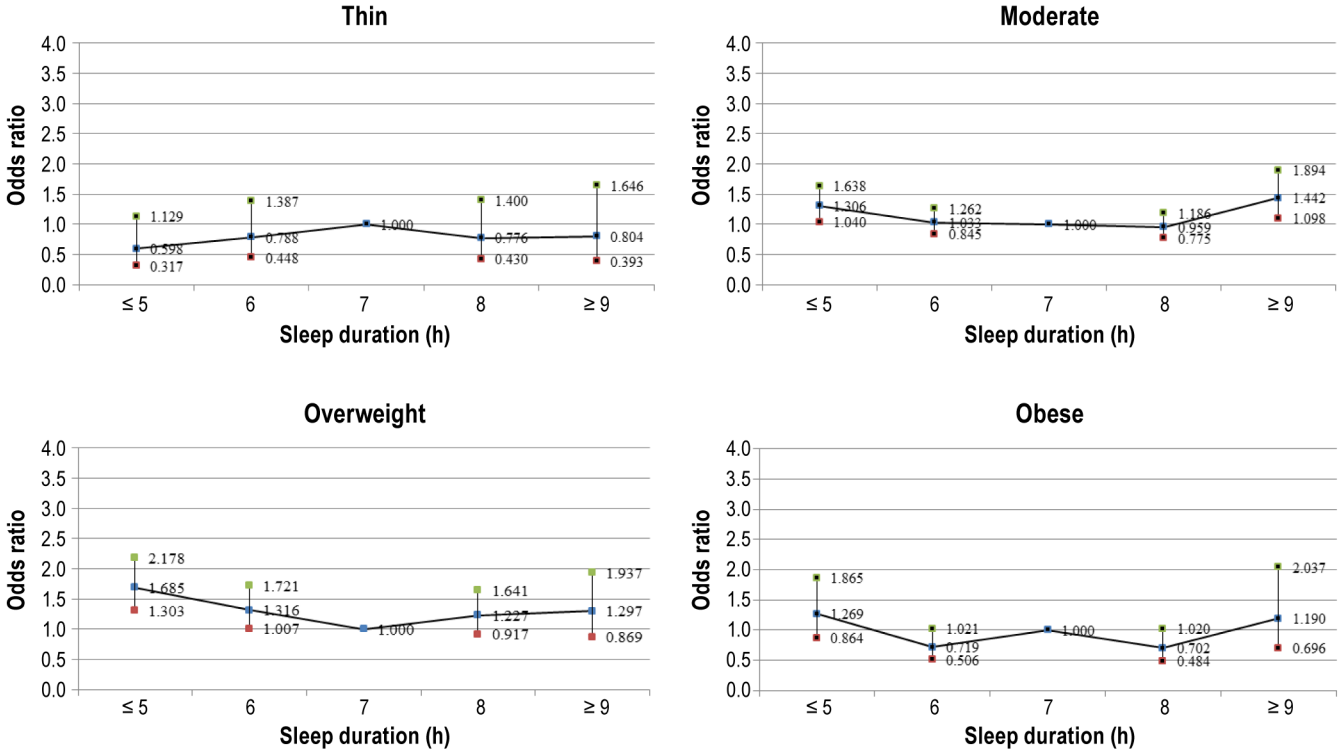
After adjusting for all these factors (**Table 2**), the odds of poor self-rated health in those ≥ 60 years of age was 1.720 times higher (95% CI 1.447-2.046) than those 19 to 39 years, and the odds of poor self-rated health in those 40 to 59 years of age was 1.365 times higher (95% CI 1.187-1.568) than those 19 to 39 years of age. The odds of poor self-rated health in females was 1.879 times higher (95% CI 1.589-2.221) than in males. The odds of poor self-rated health with low household income was 1.738 times higher (1.458-2.072) and the odds of poor self-rated health with lower middle household income was 1.326 times higher (1.115-1.576) than those with high household incomes. The odds of poor

Figure 1—Association between poor self-rated health and sleep duration for different genders



Adjusted for age, household income level, marital status, occupation, residential region, major depression diagnosed by doctor, smoking status, frequency of alcohol use, BMI, number of days of walking per week, and number of chronic diseases.

Figure 2—Association between poor self-rated health and sleep duration for different BMI categories



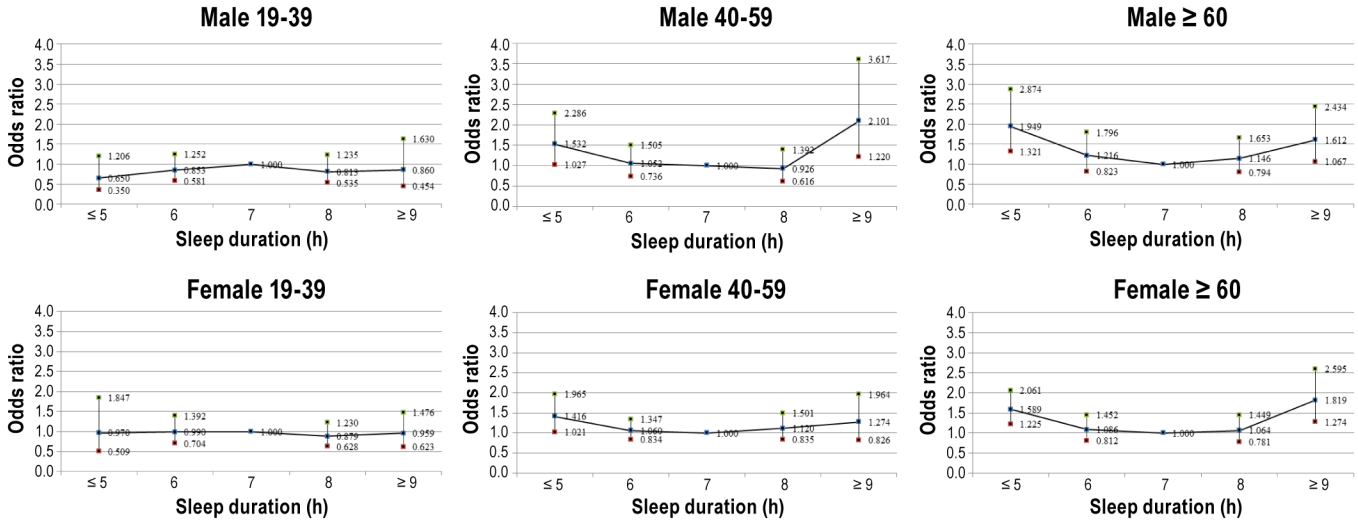
Adjusted for age, gender, household income level, marital status, occupation, residential region, major depression diagnosed by doctor, smoking status, frequency of alcohol use, number of days of walking per week, and number of chronic diseases.

self-rated health in the thin group was 1.510 times higher (95% CI 1.213-1.881) than the moderate weight group, and the odds of poor self-rated health in the obese group was 1.222 times higher (95% CI 1.044-1.430) than the moderate weight group. The odds of poor self-rated health with short sleep duration was 1.358 times higher (95% CI 1.167-1.580) than with 7-h sleep duration, and the odds of poor self-rated health with long sleep duration was 1.322 times higher (95% CI 1.091-1.601) than with 7-h sleep duration.

In subgroup analysis by gender, taking 7 h sleep as the reference category, we found that both short and long sleep duration were positively associated with poor self-rated health in both genders (**Figure 1**). In the subgroup analysis by BMI, taking 7 h sleep as the reference category, we found that both short and long sleep duration were positively associated with poor self-rated health in the moderate weight group, and the odds of poor self-rated health increased with short sleep duration in overweight participants (**Figure 2**).

In the subgroup analysis by age by gender, taking 7 h sleep as the reference category, we found that both short and long sleep duration were positively associated with poor self-rated health in males aged ≥ 40 years and females aged ≥ 60 years,

Figure 3—Association between poor self-rated health and sleep duration for different gender and age categories



Adjusted for household income level, marital status, occupation, residential region, major depression diagnosed by doctor, smoking status, frequency of alcohol use, BMI, number of days of walking per week, and number of chronic diseases.

and the odds of poor self-rated health increased in females aged 40-59 years with short sleep duration (**Figure 3**).

DISCUSSION

In this cross-sectional study of Korean adults, we found that compared to 7 hours of sleep, those with short or long duration of sleep were more likely to report poor self-rated health. This association was found to be independent of sociodemographic variables (age, gender, household income level, marital status, occupation, residential region) and health risk behavior and health status variables (major depression, smoking, alcohol intake, BMI, physical activity, number of chronic diseases). Furthermore, the association between sleep duration and poor self-rated health was consistently present in subgroup analyses of gender, BMI categories, and age by gender. In the current study, both short and long sleep durations may contribute to poor self-rated health by increasing fatigue.[46] Previous studies report that both short and long sleep duration are related to a number of adverse physiological changes, including impaired glucose tolerance,[47] inflammation,[48] and high uric acid levels,[49] which increase the risk of chronic diseases such as diabetes, obesity, and hypertension.[17] Conversely, short and long sleep duration could be a result of poor self-rated health. Individuals with poor self-rated health could be more likely to experience sleep abnormalities. In addition, long sleep duration may be a marker of undiagnosed medical conditions that affect subjective health ratings, such as sleep disordered breathing,[50] low thyroid function,[51] or undiagnosed heart failure.[52]

Recent studies report that both short and long sleep duration are associated with objective health outcomes, including diabetes mellitus,[17] hypertension,[6] CVD,[6,15] and mortality.[18] Our results indirectly suggest that poor self-rated health may be a mediator of the association among sleep durations, CVD, and mortality.[14,33,36] However, this hypothesis needs to be tested in a future study in which sleep duration, self-rated health, and CVD and mortality outcomes are simultaneously controlled. Only a few studies have examined the association between sleep duration and self-rated health, and these have had inconsistent results. In a community-based study in Canada, Segovia et al. found an association between sleep duration less than 7 hours or greater than 8 hours and poor self-rated health,[53] but they did not adjust for potential confounding factors such as depressive symptoms. In a study of more than 17,000 university students, Steptoe et al. found that only short sleep duration was associated with poor self-rated health.[54] Finally, a study by Jean-Louis et al. reports no evidence of an association between sleep duration and self-rated health in a small sample (n = 273) of California residents.[55]

In the current study, we found a significant association between sleep duration and poor self-rated health, using a sample size of 15,252. Due to our large sample size, we were able to conduct detailed subgroup analyses by gender, BMI, and age by gender, which confirmed that the association between sleep duration and self-rated health was consistently present within these subgroups. The magnitude of association was the strongest for sleep duration 5 hours or less and 9 hours or more.

Our study has a number of limitations. First, as the KNHANES survey is cross-sectional, we were unable to determine whether short and long sleep duration contribute to poor self-rated health or vice versa. However, in light of recent research, it is likely that the relationship is bi-directional. Second, because variables such as sleep duration were self-reported, there may be recall bias. Seasonal variation in responses during the 3-year period of the study may further contribute to information bias. Third, our choice of 7-hour sleep duration as the reference category is somewhat arbitrary. It is possible that the association between sleep duration and self-rated health may be more accurately revealed using alternate reference categories. On the other hand, advantages of our study include its large and nationally

representative sample size across all included communities. Therefore, it is generalizable to the Korean general public.

Future research should include longitudinal studies to establish causation and to examine how sleep duration interventions may influence multiple health and well-being outcomes.

CONCLUSION

In a large representative sample of the Korean general adult population, we found that compared to individuals with 7-hour sleep duration, individuals with short or long sleep duration were more likely to report poor self-rated health, and adequate sleep duration might have indirectly reduced adverse outcome. These results add weight to recent data emphasizing the importance of adequate sleep in physical and mental health. This association was independent of sociodemographic, health risk behavior, and health status variables. Furthermore, the association between sleep duration and poor self-rated health was consistently present in subgroups divided by gender, age, and BMI.

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