JKMS

Factors Associated with Sleep Duration in Korean Adults: Results of a 2008 Community Health Survey in Gwangju Metropolitan City, Korea

So Yeon Ryu, Ki Soon Kim and Mi Ah Han

Department of Preventive Medicine, Chosun University Medical School, Gwangju, Korea

Address for Correspondence:
So Yeon Ryu, MD
Department of Preventive Medicine, Chosun University Medical School, 309 Pilmundaero, Dong-gu, Gwangju 501-759, Korea
Tel: +82.62-230-6483, Fax: +82.62-225-8293
E-mail: canrsy@chosun.ac.kr

Short (≤ 6 hr) and long (≥ 9 hr) sleep durations are both associated with risk factors for cardiovascular diseases and diabetes, depression, learning problems, accidents and excess mortality. However, little is known about factors associated with sleep duration in Korean adults. This study examined sleep patterns in Korean adults and identified factors associated with short and long sleep durations. This study analyzed cross-sectional data collected from 4,411 Korean adults aged 19 yr and older who participated in a community health survey conducted in Gwangju, Korea. Multinomial logistic regression analysis was used to identify associations between socio-demographic and health-related factors and short or long sleep durations. Of the population, 37.2% and 4.0% reported short and long sleep, respectively. Short sleep was associated with older age, lower levels of income, night or shift work, heavy smoking, and depression or anxiety; long sleep was associated with younger age, being divorced or widowed, heavy smoking, underweight, depression or anxiety, and poorer self-reported health. In conclusion, a relatively high prevalence of short sleep duration is identified in this population of Korean adults. Factors associated with short or long sleep may act as potential confounders of the relationship between sleep duration and health outcomes.

Key Words: Sleep; Health Behavior; Socioeconomic Factors

INTRODUCTION

Both short (≤ 6 hr) and long (≥ 9 hr) sleep duration have been reported to be associated with increased risks of morbidity and mortality (1). Many studies suggest that sleep duration is associated with all-cause mortality (2-5). Other than mortality, inappropriate sleep duration has been associated with elevated body mass index (BMI), diabetes, cardiovascular disease, depression, accidents, obesity, learning and memory problems, and self-rated poor health (6-16).

In some studies, the relationship between sleep duration and health was presented as a correlation where sleep duration affected health (4), whereas in other studies, it was presented as a result of the expression of other characteristics relevant to poorer health (9). Thus, the mechanism of the relationship between sleep duration and health has not yet been explained (8). Despite the unknown mechanism, people with short or long sleep durations show distinct patterns in socio-demographic characteristics, lifestyle factors, and co-morbid diseases that are different from those of people with appropriate sleep duration (7-8 hr). Therefore, this information is useful for planning public health programs for the prevention and management of chronic disease.

Sleeping habits are multifaceted characteristics that reflect various factors, such as socio-demographic characteristics, economic status, lifestyle factors, psychological characteristics, and co-morbid diseases (8). Some studies have investigated characteristics associated with sleeping habits. Most, however, were performed on a particular population or small subject groups (18-20), and only a few studies were performed on more representative samples of the population. In particular, studies on sleep habits of Koreans have been primarily conducted on patients or shift workers (21, 22). Few studies on characteristics associated with the sleeping habits of the larger population have been conducted, except for studies on the relationship of sleeping with particular factors, like obesity (23).

In Korea, compared with previous trends, the proportion of the adult population with appropriate sleep duration, of approximately 7-8 hr per day has been reported to be decreasing (24). However, only a few studies have been conducted on the general population to investigate sleep duration distribution or factors associated with sleep duration. Accordingly, this study was performed to investigate sleep patterns in Koreans and to identify

associations of short and long sleep duration with demographic, socio-economic, behavioral, and health characteristics using data from a community health survey conducted in five districts in Gwangju Metropolitan City in 2008.

MATERIALS AND METHODS

Subjects

This study was conducted using data collected from five districts in Gwangju from community health surveys conducted by the Korean Centers for Disease Control and Prevention (KCDC) and public health centers in 2008. The 2008 community health survey was conducted to obtain statistical data on health conditions, disease morbidity, injury and intoxication to be used as bases for the establishment of the health care policy of local governments as well as the development and assessment of health care programs. The community health survey was conducted on 800-900 subjects selected by a standardized sampling method of the adult aged 19 yr or older living in each area from September to November, 2008. The community health survey was conducted by trained interviewers as a one-to-one interview based on a protocol and questionnaires with 358 questions in 13 fields (25).

The 2008 community health survey in Gwangju was conducted on 4,433 adults aged 19 or older living in five districts. Data from 4,411 participants were analyzed in this study; 22 participants who did not provide important information including sleep duration were excluded.

Variables

Sleep duration was assessed from the question "How many hours of sleep do you get in a day?" and categorized as short sleep (≤ 6 hr), appropriate sleep (7-8 hr), and long sleep (≥ 9 hr) to be consistent with previous epidemiologic studies (6, 8, 10, 23, 26).

Age at the time of the survey was classified as 19-44 yr, 45-64 yr, 65-74 yr, and 75 yr or over. Marital status was classified as unmarried, married and divorced, or widowed. Subsequently, married status was classified as currently married or unmarried (i.e., never married, divorced, or widowed). Educational background was classified as uneducated, elementary school, middle school, high school, and university or higher. Average monthly family income of the subjects was classified as one million won or less, two million won or less, three million won or less and 3.01 million won or more. Job status was classified into unemployed, daytime work, and work other than daytime work.

Times (in day units) of performing moderate physical activity per week and average hours per activity were surveyed except for walking. If subjects participated in physical activity for 5 days or more per week and for 30 min or more per activity, they were classified as having moderate physical activity. If not, they were classified as having no physical activity group. Subjects who smoked fewer than five packs of cigarettes dur-

ing their lifetime or never smoked were classified as non-smokers, those who had smoked more than five packs of cigarettes but did not currently smoke were classified as former smokers, and those who smoked more than five packs of cigarettes and currently smoked were classified as current smokers. Among current smokers, the average daily smoking amount was categorized as nine cigarettes or less, 10-19 cigarettes, and 20 cigarettes or more. The number of alcoholic drinks consumed per week was classified into 0, 1-2 glasses, 3-6 glasses, and 7 glasses or more after surveying drinking status for the past year and average drinking amount (glasses) per drinking occasion.

Body mass index (BMI) was calculated by dividing self-reported body weight (kg) by the square of self-reported height (m^2) and classified into underweight (< 18.5 kg/m^2), normal (18.5 ≤ BMI < 25.0 kg/m^2), and overweight (≥ 25.0 kg/m^2). Pain or discomfort was classified as no pain or discomfort, intermediate pain or discomfort, and severe pain or discomfort. Anxiety or depression was classified as no anxiety or depression, intermediate anxiety or depression, and severe anxiety or depression. Subjects who were diagnosed by a doctor with hypertension, diabetes mellitus, stroke, myocardial infraction, or angina pectoris were defined as patients with cardiovascular diseases. Self-rated health was ascertained from the question "In general, how do you feel about your health?" assessing health as very good, good, ordinary, poor, or very poor, and was categorized as good health, ordinary health, and poor health.

Statistical analysis

Data were analyzed using multinomial logistic regression to investigate the association of short (≤ 6 hr) and long (≥ 9 hr) sleep with various factors, using appropriate sleep (7-8 hr) as the reference group. To evaluate factors associated with sleep duration, four nested models were tested. Demographic characteristics (gender, age, marital status) were included in model 1. Socio-economic characteristics (educational background, average monthly income, job status) were added to model 2. Health behavior characteristics (moderate physical activity or higher, smoking status, drinking frequency) were added to model 3. Health condition characteristics (BMI, pain/discomfort, depression/anxiety, diagnosis of cardiovascular diseases, subjective health status) were added to model 4. The data were analyzed using SAS version 9.1 and weighted by the district population. Results are presented as odds ratios and 95% confidence intervals.

Ethics statement

The protocol of community health survey was reviewed and approved by the institutional review board of Korean Centers for Disease Control and Prevention (2010-02-CON-22-P). Written informed consent was obtained from all participants in community health survey.

RESULTS

A total of 37.2% of the subjects had short sleep and 4.0% had long sleep. A total of 36.4% of male subjects had short sleep, and 2.9% had long sleep. In contrast, 27.9% of the female subjects had short sleep and 5.1% had long sleep. As age increased, the prevalence of both short sleep and long sleep tended to increase. Of subjects currently without a spouse, 33.8% had short sleep, and 5.7% had long sleep. On the other hand, 39.0% of the subjects currently with a spouse had short sleep, and 3.1% had long sleep. As educational level increased, long sleep decreased and appropriate sleep increased. More subjects with low average monthly income tended to have short or long sleep. Among unemployed subjects, 6.8% had long sleep. A total of 61.8% of the daytime workers had appropriate sleep. Among subjects with nighttime or shift work, 54.6% had appropriate sleep; 42.2% had short sleep; and 3.2% had long sleep. Associations of sleep duration with gender, age, marital status, educational level, average monthly income, and work type were all statistically significant (Table 1).

As the smoking amount of current smokers increased, appropriate sleep tended to decrease. As the degree of obesity increased, short sleep increased, and appropriate sleep or long sleep decreased. As pain or discomfort, or anxiety or depression increased, long sleep tended to increase. Subjects who were diag-

nosed with cardiovascular diseases showed less appropriate sleep and more short or long sleep than subjects not diagnosed with a cardiovascular disease. Subjects who considered their subjective health status to be poor tended to have short or long sleep. The association of sleep duration with smoking status, alcohol intake, obesity, pain/discomfort, depression/anxiety, diagnosis of cardiovascular diseases, and subjective health status were all statistically significant, but the association with moderate physical activity or higher was not (Table 2).

The results of the four nested models are shown in Table 3. In model 1, compared with the male, the odds ratio (95% confidence interval) was 1.68 (1.17-2.40) in female for long sleep. Compared with subjects aged 19-44 yr, the odds ratio for short sleep was 1.30 (1.14-1.51) in subjects aged 45-64 yr, 1.91 (1.53-2.38) for 65-74 yr, and 1.85 (1.35-2.54) for 75 yr or over, showing a significant increase in the odds ratio for short sleep as age increased. The odds ratio for long sleep was 1.84 (1.01-3.36) in subjects aged 65-74 yr and 4.77 (3.12-7.30) in subjects aged 75 yr or older. Compared with subjects without a spouse, the odds ratio for long sleep was 0.62 (0.43-0.90) in subjects with a spouse.

In model 2, socio-economic characteristics were added and analyzed, controlling for demographic characteristics. In this analysis, compared to subjects with an educational level of university graduation or higher, the odds ratio for long sleep was 3.27

Table 1. Socio-demographic status by self-reported sleep hours in 4,411 Korean adults, 19 yr or older (Community Health Survey in Gwangju, 2008)

Variables	Total	Self-reported sleep duration			P value
		≤ 6 hr	7-8 hr	≥ 9 hr	
Total	100.0	37.2 (0.8)	58.8 (0.9)	4.0 (0.3)	
Demographic					
Sex					
Male	48.7 (0.7)	36.4 (1.1)	60.6 (1.2)	2.9 (0.4)	0.002
Female	51.3 (0.7)	27.9 (1.1)	57.0 (1.1)	5.1 (0.5)	
Age (yr)					
19-44	57.1 (1.0)	33.5 (1.1)	62.7 (1.1)	3.8 (0.4)	< 0.001
45-64	31.2 (1.0)	40.5 (1.4)	56.5 (1.4)	3.0 (0.5)	
65-74	8.2 (0.4)	48.0 (2.4)	46.8 (2.5)	5.2 (1.3)	
≥ 75	3.6 (0.3)	42.5 (3.7)	43.3 (3.3)	14.2 (2.2)	
Marital status					
Currently unmarried	36.4 (1.0)	33.8 (1.5)	60.4 (1.6)	5.7 (0.6)	< 0.001
Currently married	63.6 (1.0)	39.0 (1.0)	57.9 (1.1)	3.1 (0.4)	
Socioeconomic					
Education level					
No formal education	5.3 (0.4)	44.9 (3.2)	44.0 (3.0)	11.1 (2.0)	< 0.001
Primary school	8.8 (0.4)	45.7 (2.2)	48.8 (2.1)	5.4 (1.4)	
Middle school	8.4 (0.5)	39.0 (2.6)	55.7 (3.0)	5.3 (1.2)	
High school	39.1 (1.0)	35.1 (1.3)	60.9 (1.4)	4.0 (0.5)	
College or higher	38.4 (0.9)	35.9 (1.4)	61.6 (1.4)	2.5 (0.3)	
Monthly income					
≤ 1 million won	19.9 (0.9)	44.0 (1.8)	49.8 (1.9)	6.1 (0.8)	< 0.001
1.01-2 million won	26.3 (1.0)	34.8 (1.6)	61.3 (1.7)	3.9 (0.6)	
2.01-3 million won	23.7 (1.1)	34.4 (1.8)	61.8 (1.8)	3.7 (0.7)	
≥ 3.01 million won	30.4 (1.3)	37.4 (1.8)	60.0 (1.8)	2.6 (0.5)	
Working time					
No	37.6 (0.8)	36.7 (1.2)	56.5 (1.3)	6.8 (0.7)	< 0.001
Daytime	47.4 (0.9)	36.1 (1.2)	61.8 (1.2)	2.1 (0.3)	
Other	15.0 (0.7)	42.2 (2.1)	54.6 (2.1)	3.2 (0.7)	

*Data are weighted percents and standard errors.

(1.35-7.92) in those with no formal education, 1.61 (0.74-3.51) with elementary school, 2.42 (1.13-5.20) with middle school, and 1.27 (0.83-1.97) with high school. However, no significant association of short sleep with educational level was found. No statistical significance was found in the odds ratio of average monthly income for short or long sleep. The odds ratio for short sleep was 1.30 (1.05-1.60) in subjects with nighttime or shift work, which was significantly higher than in subjects working during the daytime. The odds ratio for long sleep was 2.50 (1.66-3.75) in subjects without a job, which was significantly higher than in subjects working during the daytime.

The association of health behavior-related factors with sleep duration was analyzed in model 3, after adjusting for demographic and socio-economic factors. In this analysis, the odds ratio for short sleep was 1.52 (1.08-2.15) in current smokers smoking 20 cigarettes or more a day, which was significantly higher than in non-smokers. Additionally, the odds ratio for long sleep was 4.37 (2.34-8.18), which was also significantly higher. No significant association of sleep duration with moderate physical activity or drinking status was found.

The association of health condition-related factors with sleep duration was analyzed in model 4, controlling for demographic characteristics, socio-economic characteristics, and health behavior. The odds ratio for long sleep was 3.11 (2.02-4.79) in the underweight, which was significantly higher than in subjects with a normal BMI. No statistically significant association of sleep duration with obesity was found. Compared with no depression or anxiety in subjects, the odds ratio for short sleep increased significantly in subjects with more severe depression or anxiety. The odds ratio for long sleep was 5.27 (1.72-16.10) in subjects with very severe depression or anxiety, which was significantly higher than in subjects with no depression or anxiety. The odds ratio for long sleep increased significantly in subjects with fair or poor self-rated health compared with subjects with good self-rated health (Table 3).

The results of the full model are presented in Table 4. Being female, older age, living with a spouse, working at night or being a shift worker, current heavy smoking, and having anxiety or de-

Table 2. Health-related characteristics by self-reported sleep hours in 4,411 Korean adults, 19 yr or older (Community Health Survey in Gwangju, 2008)

Variables	Total	Self-reported sleep duration			P value
		≤ 6 hr	7-8 hr	≥ 9 hr	
Health behavior					
Moderate physical activity					
No	91.4 (0.5)	36.7 (0.9)	59.1 (0.9)	4.1 (0.3)	0.115
Yes	8.6 (0.5)	42.3 (2.6)	54.6 (2.6)	3.1 (1.0)	
Smoking status					
No smoking	66.5 (0.7)	36.8 (1.0)	58.9 (1.1)	4.3 (0.4)	0.002
Ex-smoking	12.2 (0.5)	37.4 (2.1)	60.7 (2.1)	1.9 (0.6)	
Current smoking					
1-9 cigarettes	3.3 (0.3)	36.2 (5.0)	60.4 (4.9)	3.4 (1.3)	
10-19 cigarettes	8.2 (0.4)	34.3 (2.5)	62.9 (2.6)	2.8 (1.0)	
≥ 20 cigarettes	9.8 (0.3)	43.3 (2.9)	50.8 (2.9)	6.0 (1.3)	
Alcohol consumption					
0 glasses	34.6 (0.8)	38.1 (1.3)	56.7 (1.4)	5.2 (0.6)	0.033
1-2 glasses	18.7 (0.6)	39.5 (1.8)	56.5 (1.9)	4.0 (0.7)	
3-6 glasses	28.3 (0.8)	34.2 (1.5)	62.4 (1.6)	3.4 (0.6)	
≥ 7 glasses	18.4 (0.7)	37.8 (1.9)	59.3 (2.0)	2.9 (0.7)	
Health status					
Body mass index					
≤ 18.4 kg/m^2	6.2 (0.3)	27.2 (3.1)	59.5 (3.1)	13.2 (2.0)	< 0.001
18.5-24.9 kg/m^2	74.6 (0.7)	37.5 (1.0)	59.2 (1.0)	3.3 (0.3)	
≥ 25.0 kg/m^2	19.2 (0.7)	38.4 (1.9)	58.1 (2.0)	3.5 (0.7)	
Pain or discomfort					
No	79.9 (0.7)	35.9 (0.9)	61.0 (1.0)	3.1 (0.3)	< 0.001
A little	17.2 (0.7)	42.7 (1.9)	50.4 (2.0)	6.9 (0.9)	
Severe	2.9 (0.3)	41.0 (4.7)	47.4 (5.5)	11.7 (2.9)	
Depression or anxiety					
No	86.9 (0.6)	35.8 (0.9)	60.8 (0.9)	3.4 (0.3)	< 0.001
A little	12.0 (0.6)	46.8 (2.2)	46.4 (2.2)	6.8 (1.0)	
Severe	1.1 (0.2)	43.1 (7.2)	32.8 (6.7)	24.1 (7.3)	
Cardiovascular disease					
No	85.0 (0.6)	36.1 (0.9)	60.2 (0.9)	3.7 (0.3)	< 0.001
Yes	15.0 (0.6)	43.5 (1.9)	50.3 (1.9)	6.1 (1.0)	
Subjective health					
Good	48.5 (0.9)	35.8 (1.3)	61.9 (1.3)	2.3 (0.3)	< 0.001
Fair	35.9 (0.8)	37.4 (1.3)	58.8 (1.3)	3.7 (0.4)	
Poor	15.6 (0.6)	41.0 (2.1)	48.8 (2.2)	10.1 (1.3)	

*Data are weighted percents and standard errors.

Table 3. Odds ratios (OR) and 95% confidence intervals (CI) from 4 nested multinomial logistic regression for the relation between the covariates and self-reported sleep hours in Korean adults, 19 yr or older (Community Health Survey in Gwangju, 2008)

Variables	Self-reported sleep hours	
	≤ 6 vs 7-8 hr	≥ 9 vs 7-8 hr
	OR (95% CI)	OR (95% CI)
Model 1 (Demographic)		
Sex (/male)		
Female	1.10 (0.98-1.25)	1.68 (1.17-2.40)
Age (/19-44 yr)		
45-64 yr	1.30 (1.14-1.51)	0.98 (0.65-1.48)
65-74 yr	1.91 (1.53-2.38)	1.84 (1.01-3.36)
≥ 75 yr	1.85 (1.35-2.54)	4.77 (3.12-7.30)
Marital status (/unmarried)		
Married	1.15 (0.98-1.35)	0.62 (0.43-0.90)
Model 2 (Socioeconomic)		
Education level (/college or higher)		
No educated	1.28 (0.88-1.87)	3.27 (1.35-7.92)
Primary school	1.18 (0.93-1.52)	1.61 (0.74-3.51)
Middle school	1.08 (0.82-1.43)	2.42 (1.13-5.20)
High school	0.99 (0.83-1.18)	1.27 (0.83-1.97)
Monthly income (/≥ 3.01 million won)		
≤ 1 million won	1.26 (0.99-1.60)	1.50 (0.84-2.68)
1.01-2 million won	0.88 (0.70-1.10)	1.24 (0.74-2.08)
2.01-3 million won	0.90 (0.74-1.10)	1.31 (0.76-2.25)
Working time (/daytime)		
No job	0.91 (0.78-1.06)	2.50 (1.66-3.75)
Other time	1.30 (1.05-1.60)	1.68 (0.95-2.99)
Model 3 (Health behavior)		
Moderate physical activity (/no)		
Yes	1.13 (0.89-1.43)	1.01 (0.49-2.09)
Smoking status (/no)		
Ex-smoking	1.08 (0.83-1.41)	0.98 (0.49-1.97)
1-9 cigarettes	1.23 (0.76-2.00)	1.28 (0.46-3.58)
10-19 cigarettes	1.08 (0.80-1.45)	1.25 (0.49-3.17)
≥ 20 cigarettes	1.52 (1.08-2.15)	4.37 (2.34-8.18)
Alcohol consumption (/wk) (/0)		
1-2 glasses	1.17 (0.97-1.43)	0.99 (0.64-1.54)
3-6 glasses	1.09 (0.89-1.35)	0.99 (0.61-1.61)
≥ 7 glasses	1.19 (0.93-1.52)	0.68 (0.35-1.29)
Model 4 (Health status)		
Body mass index (/18.5-24.9 kg/m^2)		
≤ 18.4 kg/m^2	0.79 (0.60-1.09)	3.11 (2.02-4.79)
≥ 25.0 kg/m^2	1.04 (0.86-1.25)	1.05 (0.65-1.69)
Pain or discomfort (/no)		
A little	1.02 (0.82-1.26)	1.11 (0.75-1.63)
Severe	1.00 (0.64-1.55)	0.88 (0.43-1.82)
Depression or anxiety (/no)		
A little	1.46 (1.15-1.86)	1.10 (0.73-1.66)
Severe	2.54 (1.18-5.47)	5.27 (1.72-16.10)
Cardiovascular disease (/no)		
Yes	1.03 (0.85-1.26)	1.24 (0.78-1.98)
Subjective health (/good)		
Fair	0.95 (0.74-1.24)	3.27 (1.86-5.75)
Poor	0.94 (0.81-1.10)	1.71 (1.11-2.64)

pression were all associated with greater odds of short sleep. Subjects without a job, current heavy smokers, underweight subjects, those with severe anxiety or depression, and those with poor self-rated health had higher odds of long sleep.

Characteristics that showed a significant association with short and long sleep were gender, age, marital status, working type, smoking status, obesity, depression or anxiety, and subjective

health condition (Table 4).

DISCUSSION

In this analysis of sleep duration distribution in adult aged 19 yr or older living in Gwangju, 37.2% had short sleep and 4.0% had long sleep durations. Approximately 40% of the population did not have appropriate sleep duration. Appropriate sleep duration was less frequent in the population studied here than in populations of Americans (7) and Australians (6) reported previously, where short sleep duration accounted for 28.3% and 16.6% of the population, respectively, and long sleep duration accounted for 8.5% and 13.9%, respectively. According to data from the Korean National Health and Nutrition Examination Survey (KNHNES) in 2001 (23), sleep durations of Korean adults were 39.8% in short sleep and 7.3% in long sleep. Compared with the result of KNHANES in 2001, this study showed that both the population with short sleep duration and the population with long sleep duration had decreased.

Socio-economic factors associated with short or long sleep were gender, age, marital status, average monthly income, and working type. The odds ratio for short sleep was significantly higher for women, older subjects, those with lower levels of income, and those performing night or shift work. The odds ratio for long sleep was significantly higher in younger subjects and those who were unemployed, divorced, or widowed. The associations of sleep duration with socio-economic characteristics in this study were similar to the results of previous studies targeting various population groups (1, 2, 6, 7, 11, 27-29). Poor socio-economic status was particularly associated with short sleep.

Smoking status was associated with sleep duration. Compared with non-smokers, a significant association with short sleep duration was shown in current smokers smoking ≥ 40 cigarettes a day, and a significant association with long sleep was shown in current smokers smoking ≥ 20 cigarettes a day. No significant association of sleep duration with excess drinking or physical activity was demonstrated; these factors have been associated with sleep duration in previous studies (6, 7, 30). Health behaviors such as smoking seem to interfere with appropriate sleep duration by disturbing good sleep hygiene or increasing physiological stimulation (7).

Among health conditions associated with sleep duration, depression or anxiety was associated with short sleep, whereas underweight, severe depression or anxiety, and poor self-reported health were associated with long sleep. According to studies on the association of sleep with depression targeting the elderly, depression is closely associated with subjective sleep disorders such as poor quality of sleep, excess drowsiness during the daytime, and increased sleep induction time, and was reported to appear primarily in subjects with long sleep duration (10, 12). In this study, as the complaint of depression or anxiety increased,

Table 4. Odds ratios (OR) and 95% confidence intervals (CI) from full multinomial logistic regression for the relation between the covariates and self-reported sleep hours in Korean adults, 19 yr or older (Community Health Survey in Gwangju, 2008)

Variables	Self-reported sleep hours		P value
	≤ 6 vs 7-8 hr	≥ 9 vs 7-8 hr	
	OR (95% CI)	OR (95% CI)	
Demographic			
Sex (/male)			0.047
Female	1.24 (1.03-1.51)	1.49 (0.85-2.60)	
Age (/19-44 yr)			< 0.001
45-64 yr	1.20 (0.99-1.47)	0.65 (0.38-1.11)	
65-74 yr	1.60 (1.17-2.19)	0.35 (0.15-0.84)	
≥ 75 yr	1.58 (1.02-2.44)	1.14 (0.51-2.56)	
Marital status (/unmarried)			0.006
Married	1.23 (1.02-1.47)	0.70 (0.46-1.06)	
Socioeconomic			
Education level (/college or higher)			0.498
No educated	1.11 (0.76-1.61)	2.21 (0.91-5.37)	
Primary school	1.15 (0.89-1.50)	1.30 (0.64-2.63)	
Middle school	1.05 (0.78-1.40)	2.02 (0.92-4.40)	
High school	0.99 (0.82-1.18)	1.27 (0.83-2.00)	
Monthly income (/≥ 3.01 million won)			0.055
≤ 1 million won	1.21 (0.95-1.56)	1.13 (0.63-2.00)	
1.01-2 million won	0.87 (0.70-1.09)	1.13 (0.67-1.90)	
2.01-3 million won	0.90 (0.74-1.10)	1.19 (0.69-2.06)	
Working time (/daytime)			< 0.001
No job	0.94 (0.81-1.10)	2.45 (1.61-3.71)	
Other time	1.29 (1.04-1.61)	1.52 (0.86-2.69)	
Health behavior			
Mododerate physical activity (/no)			0.725
Yes	1.10 (0.86-1.40)	1.14 (0.56-2.35)	
Smoking status (/no)			0.004
Ex-smoking	1.07 (0.82-1.40)	0.90 (0.43-1.91)	
1-9 cigarettes	1.23 (0.75-2.00)	1.20 (0.38-3.74)	
10-19 cigarettes	1.06 (0.78-1.44)	1.16 (0.44-3.04)	
≥ 20 cigarettes	1.51 (1.06-2.15)	3.43 (1.83-6.43)	
Alcohol consumption (/wk) (/0)			0.532
1-2 glasses	1.14 (0.94-1.39)	1.10 (0.72-1.69)	
3-6 glasses	1.09 (0.89-1.35)	1.18 (0.72-1.95)	
≥ 7 glasses	1.18 (0.92-1.50)	0.77 (0.40-1.49)	
Health status			
Body mass index (/18.5-24.9 kg/m^2)			< 0.001
≤ 18.4 kg/m^2	0.79 (0.60-1.09)	3.11 (2.02-4.79)	
≥ 25.0 kg/m^2	1.04 (0.86-1.25)	1.05 (0.65-1.69)	
Pain or discomfort (/no)			0.963
A little	1.02 (0.82-1.26)	1.11 (0.75-1.63)	
Severe	1.00 (0.64-1.55)	0.88 (0.43-1.82)	
Depression or anxiety (/no)			0.001
A little	1.46 (1.15-1.86)	1.10 (0.73-1.66)	
Severe	2.54 (1.18-5.47)	5.27 (1.72-16.10)	
Cardiovascular disease (/no)			0.661
Yes	1.03 (0.85-1.26)	1.24 (0.78-1.98)	
Subjective health (/good)			< 0.001
Fair	0.95 (0.74-1.24)	3.27 (1.86-5.75)	
Poor	0.94 (0.81-1.10)	1.71 (1.11-2.64)	

the odds ratios for short and long sleep increased significantly, indicating that emotional instability affected both sleep quality and duration.

In some studies, the risk of obesity was reported to increase as sleep duration became shorter or longer than appropriate sleep duration. This result was identical to the results of studies with various measurement methods, such as sleep duration or structure (13, 23). The association of obesity with sleep duration is

believed to be caused by energy consumption change and appetite stimulation due to the change in hormone secretion, and the lack of physical activity due to disturbance in emotional condition for short sleep duration rather than for long sleep duration (14). However, no significant association of obesity with short sleep duration was found in this study. Additionally, the odds ratio for long sleep was significantly increased in underweight subjects compared with subjects with normal BMI. The associ-

ation of underweight with long sleep was reported in a previous study targeting Americans (7), but no detailed explanation was provided. This long sleep may be attributable to reduced activity duration due to decreased stamina in underweight subjects.

Sleep duration longer or shorter than 7-8 hr was relatively consistently reported to be associated with the morbidity or mortality from cardiovascular disease or diabetes in some studies (3, 4, 7, 15, 16, 19). However, in this study, for cardiovascular disease including hypertension, diabetes mellitus, stroke, and cardiac diseases, the odds ratio for both short and long sleep increased, but the results were not statistically significant. As the association of sleep duration with chronic diseases including cardiovascular diseases has not been studied previously in Korea, it is difficult to assess the meaning of this finding. Studies on the association of sleep duration with chronic diseases including cardiovascular diseases and mortality from these diseases are needed.

The association of long sleep duration with chronic diseases was less clear than the association of short sleep with chronic diseases. Some previous studies reported that long sleep duration was associated with excess drinking, depression, characteristics related to cancer treatment, and self-rated health. However, those results have been inconsistent among studies. In general, long sleep duration was considered not to be a risk factor for poor health but rather a result of poor health, although this needs further study (5, 8, 10).

There are some limitations to this study. First, sleep duration was self-reported without measurements of objective sleep duration. It is impossible to measure objective sleep duration in a large-scale study. Furthermore, in many studies on factors associated with sleep duration, self-reported sleep duration has been used. Napping, nap duration, and sleep quality were not considered in this study. This information should be considered in further studies. Second, it is difficult to interpret correlations as temporal associations because cross-sectional data were used. Third, information on height, body weight, and the diagnosis of diseases was collected from self-reports from the subjects. Thus, data used in this study were based on subjective responses from the subjects. That is, physical conditions such as height and body weight, and health conditions perceived or remembered by the subjects were used, but were not verified. Fourth, this study was conducted on residents of Gwangju, which may restrict their representativeness of the population of Korea. However, as the subjects in this study were selected from a population sample that represented the residents of the corresponding local government, they were suitable for the explanation of the resident characteristics. To investigate the association of sleep duration with the general population's characteristics in Korea, expansion of the population by integration with community health surveys conducted in other areas will be required. Fifth, the association of sleep duration with job activities or ordinary activities related to sleep duration was not analyzed. Such data were not available from the community health survey. Collection of information on job activities or ordinary activities related to sleep duration should be supplemented in further studies.

Nevertheless, this study is meaningful in that it was the first study targeting Koreans using large-scale data to investigate factors associated with sleep duration, and reported the association of sleep duration with various factors such as socio-economic characteristics, lifestyle factors, and health-related characteristics.

In conclusion, a relatively high prevalence of short sleep duration is identified in this population of Korean adults. Socio-economic characteristics, lifestyle factors such as smoking, and health-related characteristics, such as depression, are shown to be associated with short sleep duration. Socio-economic characteristics and depression are also shown to be associated with long sleep duration. Factors associated with short or long sleep may act as potential confounders of the relationship between sleep duration and health outcomes. Further studies in more diverse populations and using various study methods will be required to investigate the effect of sleep duration on health and the relevant mechanism as well as to additionally explore the role of sleep duration as an index that reflects health conditions.

ACKNOWLEDGMENTS

REFERENCES

1. Basner M, Fomberstein KM, Razavi FM, Banks S, William JH, Rose RR, Dinger DF. *American time use survey: sleep time and its relationship to waking activities. Sleep 2007; 30: 1085-95.*

2. Ferrie JE, Shipley MJ, Cappuccio FP, Brunner E, Miller MA, Kumari M, Marmot MG. *A prospective study of change in sleep duration: association with mortality in the Whitehall II cohort. Sleep 2007; 30: 1659-66.*

3. Heslop P, Smith GD, Metcalfe C, Macleod J, Hart C. *Sleep duration and mortality: the effect of short or long sleep duration on cardiovascular and all-cause mortality in working men and women. Sleep Med 2002; 3: 305-14.*

4. Shankar A, Koh WP, Yuan JM, Lee HP, Yu MC. *Sleep duration and coronary heart disease mortality among Chinese adults in Singapore: a population-based cohort study. Am J Epidemiol 2008; 168: 1367-73.*

5. Gangwisch JE, Heymsfield SB, Boden-Albala B, Buijs RM, Kreier F, Opler MG, Pickering TG, Rundle AG, Zammit GK, Malaspina D. *Sleep duration associated with mortality in elderly, but not middle-aged, adults in a large US sample. Sleep 2008; 31: 1087-96.*

6. Magee CA, Iverson DC, Caputi P. *Factors associated with short and long sleep. Prev Med 2009; 49: 461-7.*

7. Krueger PM, Friedman EM. *Sleep duration in the United States: a cross-sectional population-based study. Am J Epidemiol 2009; 169: 1052-63.*

8. Stranges S, Dorn JM, Shipley MJ, Kandala NB, Trevisan M, Miller MA, Donahue RP, Hovey KM, Ferrie JE, Marmot MG, Cappuccio FP. *Correlates of short and long sleep duration: a cross-cultural comparison between the United Kingdom and the Unites States. The Whitehall II Study and the Western New York Health Study. Am J Epidemiol 2008; 168: 1353-64.*

9. Zee PC, Turek FW. *Sleep and health: everywhere and in both directions. Arch Intern Med 2006; 166: 1686-88.*

10. Amagai Y, Ishikawa S, Gotoh T, Kayaba K, Nakamura Y, Kajii E. *Sleep duration and incidence of cardiovascular events in a Japanese population: the Jichi Medical School Cohort Study. J Epidemiol 2010; 20: 106-10.*

11. Scott LD, Hwang WT, Rogers AE, Nysse T, Dean GE, Dinges DF. *The relationship between nurse work schedules, sleep duration, and drowsy driving. Sleep 2007; 30: 1801-7.*

12. Paudel ML, Taylor BC, Diem SJ, Stone KL, Ancoli-Israel S, Redline S, Ensrud KE. *Association between depressive symptoms and sleep disturbances in community-dwelling older men. J Am Geriatr Soc 2008; 56: 1228-35.*

13. Marshall NS, Glozier N, Grunstein RR. *Is sleep duration related to obesity? A critical review of the epidemiological evidence. Sleep Med Rev 2008; 12: 289-98.*

14. Bjorvatn B, Sagen IM, Øyane N, Waage S, Fetveit A, Pallesen S, Ursin R. *The association between sleep duration, body mass index and metabolic measures in the Hordaland Health Study. J Sleep Res 2007; 16: 66-76.*

15. Gangwisch JE, Heymsfield SB, Boden-Albala B, Buijs RM, Kreier F, Pickering TG, Rundle AG, Zammit GK, Malaspina D. *Short sleep duration as a risk factor for hypertension: analyses of the first National Health and Nutrition Examination Survey. Hypertension 2006; 47: 833-9.*

16. Gottlieb DJ, Punjabi NM, Newman AB, Resnick HE, Redline S, Baldwin CM, Nieto FJ. *Association of sleep time with diabetes mellitus and impaired glucose tolerance. Arch Intern Med 2005; 165: 863-7.*

17. Quan SF, Zee P. *Evaluating the effects of medical disorders on sleep in the older patient. Geriatrics 2004; 59: 37-42.*

18. Adams J. *Socioeconomic position and sleep quantity in UK adults. J Epidemiol Community Health 2006; 60: 267-9.*

19. Gottlieb DJ, Redline S, Nieto FJ, Baldwin CM, Newman AB, Resnick HE, Punjabi NM. *Association of usual sleep duration with hypertension: the Sleep Heart Health Study. Sleep 2006; 29: 1009-14.*

20. Steptoe A, Peacy V, Wardle J. *Sleep duration and health in young adults. Arch Intern Med 2006; 166: 1689-92.*

21. Lee JT, Lee KJ, Park JB, Lee KW, Jang KY. *The relations between shiftwork and sleep disturbance in a University Hospital Nurses. Korean J Occup Environ Med 2007; 19: 223-30.*

22. Kim YG, Yoon DY, Kim JI, Chae CH, Hong YS, Yang CG, Kin JM, Jung KY, Kim JY. *Effects of health on shift-work: general and psychological health, sleep, stress, quality of life. Korean J Occup Environ Med 2002; 14: 247-56.*

23. Park YJ, Lee WC, Yim HW, Park YM. *The association between sleep and obesity in Korean adults. J Prev Med Public Health 2007; 40: 454-60.*

24. Ministry of Health & Welfare. *2001 National Health and Nutrition Survey: halth behavior. Seoul: Ministry of Health & Welfare, 2002.*

25. Korea Center for Disease Control and Prevention. *Community Health Survey Operational Guide. Seoul: Korea Center for Disease Control and Prevention, 2008.*

26. Stamatakis KA, Kaplan GA, Roberts RE. *Short sleep duration across income, education and race/ethnic groups: population prevalence and growing disparities over 34 years of follow up. Ann Epidemiol 2007; 17: 948-55.*

27. Patel SR, Malhotra A, Gottlieb DJ, White DP, Hu FB. *Correlates of long sleep duration. Sleep 2006; 29: 881-9.*

28. Hale L. *Who has time to sleep? J Public Health (Oxf) 2005; 27: 205-11.*

29. Moore PJ, Adler NE, Williams DR, Jackson JS. *Socioeconomic status and health: the role of sleep. Psychosom Med 2002; 64: 337-44.*

30. Ohayon MM. *Interactions between sleep normative data and socio-cultural characteristics in the elderly. J Psychosom Res 2004; 56: 479-86.*

AUTHOR SUMMARY

Factors Associated with Sleep Duration in Korean Adults: Results of a 2008 Community Health Survey in Gwangju Metropolitan City, Korea

So Yeon Ryu, Ki Soon Kim and Mi Ah Han

This study examined sleep patterns in 4,411 Korean adults and identified factors associated with short and long sleep durations. Of the population, 37.2% and 4.0% reported short and long sleep, respectively. Short sleep was associated with older age, lower levels of income, night or shift work, heavy smoking, and depression or anxiety; long sleep was associated with younger age, being divorced or widowed, heavy smoking, underweight, depression or anxiety, and poorer self-reported health.