



# Association between Sleep Problems and Sedentary Behaviors during Work among Korean Workers

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(Received 12 Feb 2020; accepted 11 Apr 2020)

## Abstract

**Background:** We aimed to identify the association between sleep problems and sedentary behaviors during work among Korean workers.

**Methods:** We employed a cross-sectional survey, and analyzed data from the 5<sup>th</sup> Korean Working Conditions Survey, conducted in 2017. The participants were 50,205 workers aged 15 years and above. The data were analyzed using Pearson's correlation, chi-square distribution, and logistic regression.

**Results:** Sleep problems occurred more frequently among female participants with higher ages; those with low educational levels; skilled agricultural, forestry, and fishery workers; elementary workers; and service and sales workers. With general characteristics as control variables, it was found that the odds of sleep problems were 5.547 times higher if the duration of sedentary behavior was longer.

**Conclusion:** It is important to improving work environment and provide education on various physical activities for workers with a long duration of sedentary behaviors to reduce sleep problems among them.

**Keywords:** Employees; Working conditions; Sleep problems

## Introduction

According WHO, more than 60% of the world's population has less than 30 minutes of medium-level physical activities, which is the minimum recommended amount of activity (1). Sedentary behavior is especially a global problem in public health. Sedentary behaviors include any waking behaviors characterized by energy expenditure  $\leq 1.5$  metabolic equivalents while in a sitting, reclining, or lying posture (2). Sedentary behaviors are highly related to obesity, type II diabetes, and cardiovascular diseases (3). Especially, as workers spend one third of their day working, working conditions with mostly sedentary behaviors can cause health problems (4). In addition, examining

workers' sedentary behaviors are important as prior studies found that longer duration of sedentary behaviors at the workplace leads to a longer duration of sedentary behaviors at home as well (5).

There has been a recent increase in the interest in the association between sedentary behaviors and sleep problems. Sleep problems are among the most common health problems experienced by 10-20% of the world's population (6). Sleep problems can be categorized into three different categories: lack of sleep including insomnia, disturbed sleep including sleep apnea, and excessive sleep including narcolepsy (7). The American



Sleep Association reported that at least 40 million Americans experience chronic or long-term sleep problems (8). Sleep problems decrease the quality of life and increase the possibility of depression, metabolic syndromes, diabetes, cardiovascular diseases and death rates (9). Sleep problems are not only a type of social problem that lowers the productivity of workers and companies (10), but also a major public health concern as they cause physical and mental health problems (11).

There are only a few studies on the association between sedentary behaviors and sleep problems, and the results are inconsistent. Sedentary behaviors and sleep have an interdependent relationship (9, 12). These studies explain the mechanism of the association between sedentary behaviors and sleep problems as sedentary behaviors lowering the body temperature leading to its inability to induce sleep (13). However, other studies report no associations between sedentary behaviors and sleep problems (14, 15). Furthermore, there are inadequate studies on sedentary behaviors during work to identify the association with sleep problems.

Therefore, we aimed to provide basic data for interventions to reduce workers' sleep problems according to the characteristics of their sedentary behaviors by identifying the association between sleep problems and sedentary behaviors at the workplace by applying the workplace environment survey data for workers in Korea at various age levels. The detailed aims of this study are mentioned below.

- Identifying the individual characteristics of the participants and the differences in sleep problems according to the individual characteristics
- Identify the association between sleep problem and sedentary behaviors

## Materials and Methods

### Design

We used a cross-sectional design by applying the data from the 2017 5<sup>th</sup> Korean Working Conditions Survey (KWCS-V) to identify the association between sleep problems and sedentary behaviors during work among Korean workers.

### Sampling and Data Collection

The KWCS-V is provided as open data by the Korea Occupational Safety & Health Agency. The KWCS-V was conducted door-to-door from July 11, 2017 to November 1, 2017. The participants in the survey were 50,205 workers (employees, employers, self-employed, etc.) aged 15 years and above, from all households of Korea, who were selected through a complex sample design of stratified three-stage cluster sampling, and the data of the same participants were thus included in this study.

### Instruments

#### Sedentary behaviors

Sedentary behaviors were measured with qualitative variables such as answers of “during entire work hours,” “during almost the entire work hours,” “3/4 of my work hours,” “half of my work hours,” “1/4 of my work hours,” “mostly do not engage,” and “never engage” to items: 1. Continuously standing and 2. Sitting down for the question “Does your work condition include the following items?” For this study, sedentary behaviors were defined in terms of the amount; after converting them to values of 1, 1, 0.75, 0.5, 0.25, 0, and 0, respectively, they were used in the analysis as quantitative variables.

#### Sleep problem

Sleep problems were measured as a qualitative variable with answers of “everyday,” “many times per week,” “many times per month,” “rarely,” and “none” to items of 1. Difficulty falling asleep, 2. Waking up repeatedly during sleep, and 3. Waking up when exhausted and extremely tired for the question “For the past 12 months, how frequently have you experienced the following problems?” Sleep problem was then converted to a score of 1 for at least one response out of the three questions that were checked “everyday,” “many times per week,” “many times per month,” and 0 otherwise, and then used in the analysis as a binary variable.

#### Sociodemographic and socioeconomic status information

By analyzing the data from this study and referring to prior studies, as general characteristics

such as sex, age, education level, job, and monthly average household income (million KRW= \$1,000) can affect the results of the study, they were applied as control variables in the analysis model. Age was used as a categorical variable with those in their 20s and younger, 30s, 40s, 50s, 60s and older, and education level as a qualitative variable including below middle school graduation, high school graduation, and college graduation and above. Job was used as a qualitative variable with 6 levels by recategorizing the standard job categories of Statistics Korea according to this study, which resulted in categories of: managers, professionals and related workers; clerks; service and sales workers; skilled agricultural, forestry, and fishery workers; craft, equipment, machine operating, and assembly line workers; and elementary workers. Monthly average household income was measured as a quantitative variable and used directly in the analysis.

### ***Ethical Considerations***

The study was approved by the Institutional Review Board (IRB no 2019-0105) of the researchers' university. Ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, have been completely monitored by the author.

### ***Data Analysis***

The Korean Working Conditions Survey has a complex sampling involving the two-way stratified three-stage cluster design through a weighted assumption of complex (proc surveyfreq, proc surveylogistic, etc. of SAS 9.4). To select the control variables, differences in sleep problems according to general characteristics were analyzed using the cross-analysis (homogeneity test) applying the chi-square distribution. Logistic regression was employed to identify the relationship between sedentary behaviors and sleep problem by using controlled variables. The association of sleep problems without control variables was analyzed using the point biserial correlation coefficient because sleep problem is a binary qualitative variable. Although the point biserial correla-

tion coefficient cannot be used for testing the hypothesis, it has the same result as the Pearson's correlation coefficient. Therefore, the Pearson's correlation coefficient was used for the hypothesis test.

## **Results**

### ***Difference in Sleep Problems According to General Characteristics***

Upon investigating the differences in sleep problems according to general characteristics, most variables were found to have statistically significant differences (Table 1). Women had more sleep problems than did men. The possibility of sleep problems increased with age. The possibility of sleep problems was higher among those with lower educational levels. Skilled agricultural, forestry, and fishery workers; elementary workers; and service and sales workers reported relatively more sleep problems. Average monthly household income did not show differences in sleep problems.

### ***Association between Sleep Problems and Sedentary Behaviors***

Table 2 shows the results of the analysis using the point-biserial correlation coefficient and the logistic regression to analyze the association between sleep problems and sedentary behaviors. A positive one-on-one relationship (0.115) was found between sedentary behaviors and sleep problems without applying any control variables, thus indicating a higher possibility of sleep problems with more sedentary behaviors. Then, the results were analyzed using logistic regression with general characteristics (sex, age, education level, job, and household income) as control variables, sedentary behaviors as independent variables, and sleep problem as the dependent variable. The results revealed 5.547 higher odds of sleep problems for those engaging in sedentary behaviors for the entire day than none in a day. In other words, workers with lower activity levels and more sedentary behaviors were found to have more sleep problems.

**Table 1:** General characteristics and their effects on sleep problems

<i>Variable</i>		<i>Total</i>	<i>Sleep problems</i>	
		<i>%</i>	<i>%, Odds Ratio</i>	<i>chi (p)</i>
Total			20.5	
Sex	Male	57.1	19.6	19.030
	Female	42.9	21.7	(<0.001)
Age (years)	20's or younger	14.8	17.8	124.483
	30's	21.1	17.4	(<0.001)
	40's	24.5	19.8	
	50's	23.3	23.0	
	60's or older	16.3	24.4	
Education level	Below middle school graduation	12.1	25.7	135.702
	High school graduation	34.7	22.0	(<0.001)
	College graduation and above	53.2	18.4	
Job	Managers, professionals, and related workers	20.6	17.9	116.980
	Clerks	19.0	17.6	(<0.001)
	Service and sales workers	25.2	22.8	
	Skilled agricultural, forestry, and fishery workers	5.4	24.5	
	Craft, equipment, machine operating, and assembly line workers	20.5	20.6	
	Elementary workers	9.3	23.7	
Average monthly household income (million KRW)		2.8±2.6	0.996	0.450
				(0.501)

## Discussion

We aimed to identify the association between sleep problems and sedentary behaviors of Korean workers, and the key issues based on the specific results of this study are described below. First, this study showed that sleep problems were significantly higher among women with higher ages and lower education levels. The result that women have more sleep problems than men do is consistent with results from prior studies (16, 17). The reason for this is considered to be the difference in duration of sleep due to social responsibilities such as housework and child care, and the tiredness and physical inconvenience that follow (18). Furthermore, in terms of the bi-rhythmic differences, women may experience more sleep problems due to frequent change in

the hormone levels as obstacles to sleep (19). Sleep problems were significantly higher among those with older age and lower education level in this study. Such result is consistent with those of prior studies (20, 21). As people age, they experience difficulties in sleeping due to changes in the sleep-wake schedule, and sleep deficits as sleep becomes light and short (22). Additionally, people with lower education levels have low accessibility to services for health promotion or obstacles that affect activities that promote their health, leading to poor subjective health statuses (23). According to the Working Conditions Survey, 20% of wage and salaried workers are temporary (non-regular) workers, which leads to the possibility of greater sleep problems among these workers who generally have lower education levels.

**Table 2:** Association between sedentary behaviors and sleep problems

<i>Variable</i>		<i>Sleep problems</i>	
		<i>Odds Ratio</i>	<i>Wald (p)</i>
Sedentary behaviors		5.547	690.984 (<0.001)
Sex (ref=Male)	Female	1.092	12.521 (<0.001)
Age (yr) (ref=20's and younger)	30's	1.055	1.737 (0.188)
	40's	1.189	19.735 (<0.001)
	50's	1.350	56.945 (<0.001)
	60's and older	1.343	36.133 (<0.001)
Education level (ref=Below middle school graduation)	High school graduation	0.891	6.836 (0.009)
	Above college graduation	0.833	12.960 (<0.001)
Job (ref=Skilled agricultural, forestry and fishery workers)	Managers, professionals, and related workers	0.854	6.159 (0.013)
	Clerks	0.824	9.268 (0.002)
	Service and sales workers	1.066	1.232 (0.267)
	Craft, equipment, machine operating, and assembly line workers	0.953	0.685 (0.408)
	Elementary workers	1.075	1.431 (0.232)
Household income (million KRW)		1.009	4.238 (0.040)
Model fit	Wald (p)		1016.649 (<0.001)
	Cox and Snell's R-square		0.021
	Nagelkerke's R-square		0.034
Point biserial correlation coefficient between sedentary behaviors			0.115 (<0.001)

There should be a healthier working environment and welfare benefits for them. Hence, workers' sex, age, and education level should be considered when designing policies or programs to enhance health standards, such as addressing their sleep problems. Long-term sleep problems in workers not only decrease productivity but can also cause disasters and diseases (10, 11). Therefore, nurses who look after the health of the workers in the industrial field should understand workers with sleep problems and attempt to design methods and programs to reduce such problems.

Second, skilled agricultural, forestry, and fishery workers, elementary workers, and service and sales workers had the most sleep problems. The result is contrary to those from prior studies in which the quality of sleep of farmers was the highest among 18,316 Chinese workers and the lowest among professionals (24), and sleep problem was the least in agricultural, forestry, and

fishery workers among 62,871 workers in the United States, and the highest for workers in the manufacturing industry (25). As sleep problem is affected by not only personal factors such as daily habits and psychological stress, but also work environmental factors such as long work hours, shift work, and job stress (26-28), it is difficult to simply interpret occupations as an influential factor. Therefore, future studies should analyze the differences within each job after modifying the health activities, current health status, work hours, and activities outside the workplace of the individuals.

Third, it was found that sleep problems are higher with a longer period of sedentary behaviors during work hours. The relationship between sleep problems and sedentary behavior has revealed that sleep problems can cause exhaustion or tiredness, thereby increasing sedentary behaviors (29). If people go to work without enough sleep, the feeling of tiredness and sleepiness dur-

ing work hours lowers activity and strengthens sedentary behaviors. Furthermore, regardless of physical activity, sedentary behavior can lead to awareness of daily exhaustion and increase the feeling of sleepiness (7). Therefore, experiments should confirm whether interventions to reduce sedentary behaviors improve the quality of sleep. Studies have reported that it is possible to decrease the risk of death due to sleep problems if sedentary behaviors are replaced by walking or other physical activities even if the duration of sleep is the same (30). Sleep problems among workers lower their efficiency while working, and there are higher possibilities of decrease in concentration and judgment and increase in accidents and disasters if there is intense sleepiness during the day. Therefore, programs are needed within the workplace to improve the quality of sleep by identifying areas that can harm the productivity of the organization due to sleep problems within each occupation.

International and national studies on interventions for improving the quality of sleep showed meaningful results the quality of sleep increases with 1.5 to 3 hours of Tai-chi exercise for 6 to 24 weeks among adults (31). In addition, it was found that Sleep Hygiene Education and Behavioral Therapy (32) also assist in improving the quality of sleep. The Australian Government Department of Health also reported guidelines on physical activities and sedentary behaviors for adults aged between 18 and 64 years (33). This guideline provides tips on reducing sedentary behaviors, such as eating lunch outside or at a spot other than the desk, reading while standing up, moving the trash can away from the desk compelling one to stand up to throw the garbage, requesting “walk and talk” meetings instead of “sit down” meetings, and informing people of sedentary behaviors that last for a certain period of time through alarms on cell phones or computers. Applying sit-stand desks is another improvement in the workplace to reduce the duration of sedentary behaviors (34). Activity-permissive workstations do not affect work performance and are effective in reducing sedentary behaviors while working (34).

Furthermore, increasing sedentary breaks while applying cognitive behavioral sleep programs can also enhance the concentration and reduce exhaustion of those who experience sleep problems (13, 35, 36). Therefore, there should be interventions appropriate for all workers considering the disposition and working conditions of individuals. The limitations of this study are as follows. Firstly, a causal relationship among the variables was not established as this was a cross-sectional study analyzing secondary data. Therefore, future longitudinal studies may examine such an association. Secondly, as the tools used for measurement in this study rely on self-reports, the results are not objective, and the possibility of erroneous perceptions about sedentary behaviors and sleep problems of the individuals cannot be excluded. Collecting more accurate data is considered possible if polysomnography machines or activity recording machines that are more objective are used simultaneously. Third, as sleep is highly influenced by numerous variables such as age, sex, daily habits such as drinking and smoking, and work hours, future studies on long-term randomized controlled trials to identify the effects of reducing sedentary behaviors by controlling the extraneous variables on the increase in sleep quality, long-term health, and workplace-related variables.

## **Conclusion**

The results of the current research have revealed associations between sleep problems and sedentary behaviors during work among workers. Therefore, it is necessary to develop intervention programs to reduce sedentary behavior in workplace, and strengthen welfare systems and policies for workers. Research to confirm the effectiveness of these interventions and strategies is also needed.

## **Ethical considerations**

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or fal-

sification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

## Acknowledgements

Korea Centers for Disease Control and Prevention provided the data for this study. This study was supported by the National Research Foundation of Korea grant funded by the Korea government (Ministry of Science, ICT, & Future Planning) (No.2017R1C1B 5075783).

## Conflict of interest

The authors have no actual or potential conflict of interest.

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