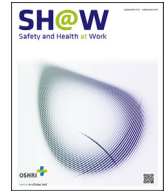




Contents lists available at ScienceDirect

## Safety and Health at Work

journal homepage: [www.e-shaw.net](http://www.e-shaw.net)

## Original Article

# Long Commute Time and Sleep Problems with Gender Difference in Work–Life Balance: A Cross-sectional Study of More than 25,000 Workers

Soojin Kim<sup>1,5</sup>, Yangwook Kim<sup>1,2</sup>, Sung-Shil Lim<sup>1,2</sup>, Jae-Hong Ryoo<sup>4</sup>, Jin-Ha Yoon<sup>1,2,3,\*</sup><sup>1</sup> Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, Republic of Korea<sup>2</sup> Graduate School of Public Health, Yonsei University, Seoul, Republic of Korea<sup>3</sup> The Institute for Occupational Health, Yonsei University College of Medicine, Seoul, Republic of Korea<sup>4</sup> Departments of Occupational and Environmental Medicine, School of Medicine, Kyung Hee University, Seoul, Republic of Korea<sup>5</sup> Yonsei University College of Medicine, Seoul, Republic of Korea

## ARTICLE INFO

## Article history:

Received 30 March 2019

Received in revised form

19 July 2019

Accepted 6 August 2019

Available online 13 August 2019

## Keywords:

Commute time

Sleep problems

Work–life balance

Working hours

## ABSTRACT

**Background:** There is a lack of statistical analysis investigating the relationship between sleep problems and commute time in Korea. We aimed to analyze the association between representative health symptoms, sleep disturbances, and commute time according to working hours in Korea.

**Methods:** The 4th Korean Working Conditions Survey data were used for analysis, and unpaid family workers and workers who work fewer than three days in a week were excluded. Commute time, working hours, and sleep hours were assessed using self-reported questionnaires. Odds ratios (ORs) with 95% confidence intervals (CIs) for sleep problems were calculated using a multivariate logistic regression model with  $\leq 10$  min commute time as the reference group.

**Results:** Among a total of 28,804 workers (men = 14,945, women = 13,859), 2.6% of men and 3.2% of women experienced sleep problems. In both sexes, long commute time (51–60 minutes and  $> 60$  minutes) showed an increased OR [men, 2.03 (CI = 1.32–3.13) and 2.05 (CI = 1.33–3.17); women, 1.58 (CI = 1.05–2.39) and 1.63 (CI = 1.06–2.50), respectively]. In stratification analysis of working hours, long commute time (51–60 and  $> 60$  minutes) showed an increased OR in men working  $> 40$  hours/week [2.08 (CI = 1.16–3.71) and 1.92 (CI = 1.08–3.41), respectively]. Furthermore, long commute time (41–50, 51–60, and  $> 60$  minutes) showed an increased OR in women working  $> 40$  hours/week [2.40 (CI = 1.27–4.55), 2.28 (CI = 1.25–4.16), and 2.19 (CI = 1.17–4.16), respectively]. Moreover, commute time  $> 60$  minutes showed an increased OR in women working  $\leq 40$  hours/week [1.96 (CI = 1.06–3.62)].

**Conclusion:** This large cross-sectional study highlights that long commute time is related to sleep problems in both sexes. Shorter commute times and decreased working hours are needed to prevent sleep problems in workers.

© 2019 Occupational Safety and Health Research Institute, Published by Elsevier Korea LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Occupation is an essential social role and provides the opportunity to obtain the goods needed to maintain quality of life. However, specific work environments can disrupt health; such environments entail long working hours [1,2], shift work [3,4], and hazardous chemical exposure [5,6]. Sleep problems are a representative health problem that can be caused by the occupational

environment; sleep problems may also reduce worker productivity and can result in fatal outcomes in specific occupations such as drivers [7,8].

Previous studies have indicated that commute time is highly related to some subjective health problems of workers. For instance, long commute time negatively affects adequate sleep, resulting in sleep problems [9–11]; those might relate to the work–life balance [12]. In addition, long commute time results in chronic

Abbreviations: KWCS, 4th Korean Working Conditions Survey; OR, odds ratio; CI, confidence interval; HPA, hypothalamic–pituitary–adrenal.

\* Corresponding author. The Institute for Occupational Health, Department of Preventive Medicine, Yonsei College of Medicine, 50-1, Yonsei-ro, Seodaemun-gu, Seoul, 03722, Republic of Korea.

E-mail address: [flyinyou@gmail.com](mailto:flyinyou@gmail.com) (J.-H. Yoon).

2093-7911/\$ – see front matter © 2019 Occupational Safety and Health Research Institute, Published by Elsevier Korea LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.shaw.2019.08.001>

fatigue and may be related to cardiovascular disease [13]. In addition to commute time, long working hours and shift work are risk factors for sleep disturbances [14,15]. There is a gender-specific study regarding gender differences in relation to occupational environment and sleep problems [16]. However, more comprehensive studies are needed to clarify the association between sleep problems and commute time with gender difference.

Moreover, there is a specific lack of comprehensive study in Asia, but cultural differences such as authority of work schedule for family life and traditional family roles are important issues for work–life balance. Therefore, we aimed to analyze the association between representative health symptoms, sleep disturbances, and commute time according to working hours in the Asian population with discussion of the work–life balance concept. Herein, to better understand the relationship between the work environment and sleep problems, we provide a comprehensive, gender-specific analysis, including work characteristics such as income, authority to self-determine a work schedule, commute time, and working hours.

## 2. Materials and methods

### 2.1. Participant data

The 4th Korean Working Conditions Survey (KWCS) was used for data analysis. The KWCS was administered to workers aged 15 years or older, using multistage random sampling according to the structure of the Korean census data set. Among a total of 50,007 workers, we excluded 9,189 participants who had missing variables regarding the following data in the questionnaire: sleep problems, commute time, working hours, period of employment, company size, job satisfaction, authority to self-determine a working schedule, shift work, regularity of commute, income, and health problems.

All economic active populations including self-employed and paid workers were enrolled in the present study, but unpaid family workers and workers who worked fewer than three days weekly were excluded ( $n = 12,014$ ). Finally, data of 28,804 workers were analyzed.

All participants of the KWCS provided written informed consent, and all information of participants was deleted before data analyses. The Institutional Review Board of the Yonsei University Health System approved this study (Y-2017-0035).

Self-reported commute time was divided into seven groups:  $\leq 10$ , 11–20, 21–30, 31–40, 41–50, 51–60, and  $> 60$  minutes. That commute time covered a round trip per day. As a 40-hour work-week is considered typical in Korea, working hours were divided into two groups:  $\leq 40$  hours/week and  $> 40$  hours/week. Period of employment contracts was categorized as  $> 1$  year, 1 month–1 year, and  $< 1$  month. The existence of sleep problems was defined as “yes” or “no” based on responses, indicating the worker reported sleep problems during the last 12 months.

Authority to self-determine a working schedule was divided into fully possible, possible, impossible, and fully impossible. We classified the four choices into two groups: “yes” for fully possible and possible and “no” for impossible and fully impossible. Work shift and regularity of the commute were divided into groups of “yes” and “no.” Income was divided into four groups:  $\leq 12$ ,  $\leq 20$  and  $> 12$ ,  $\leq 30$  and  $> 20$ , and  $> 30$  million won (KRW). Company size was divided into four groups according to the number of employees: 1–10, 11–50, 51–100, and  $> 100$  employees.

### 2.2. Statistical analysis

Chi-square tests were used to examine gender stratification of sleep problems according to study participant characteristics. Odds

ratios (ORs) with 95% confidence intervals (CIs) for the existence of subjective sleep problems were calculated using a multivariate logistic regression model. The  $\leq 10$ -minute commute time group was categorized as the reference group for sleep problems in both men and women. The P-values less than 0.05 were regarded as statistically significant. All analyses were conducted using R version 3.5.3 [19].

## 3. Results

The basic occupational characteristics of men and women are shown in Table 1. Data of 28,804 workers (men = 14,945, women = 13,859) were analyzed. The mean age of men and women was 48.1 years and 47.1 years, respectively. In men, 2.6% reported sleep problems, and in women, 3.2% reported sleep problems. Moreover, 14.2% of men and 14.2% of women reported a commute time of  $\leq 10$  minutes, whereas 12.4% of men and 8.3% of women reported a commute time of  $> 60$  minutes. A higher proportion of men worked overtime ( $> 40$  hours) compared with that of women

**Table 1**  
Basic characteristics of study participants

Basic characteristics	Men		Women	
	N = 14945	%	N = 13859	%
Sleep problems				
Yes	386	2.6	449	3.2
No	14593	97.4	13410	96.8
Commuting time				
$\leq 10$	2124	14.2	1962	14.2
11–20	2987	19.9	3281	23.7
21–30	2974	19.9	2986	21.5
31–40	2490	16.6	2335	16.8
41–50	950	6.3	851	6.1
51–60	1601	10.7	1297	9.4
$> 60$	1853	12.4	1147	8.3
Working hours (h)				
$\leq 40$ hours	6104	40.8	6727	48.5
$> 40$ hours	8875	59.2	7132	51.5
Period of employment				
$> 1$ year	4162	27.8	3568	25.7
1 month–1 year	1177	7.9	674	4.9
$< 1$ month	9640	64.4	9617	69.4
Company size				
$< 10$ workers	8428	56.3	8824	63.7
11–50 workers	4347	29.0	4036	29.1
51–100 workers	1345	9.0	741	5.3
$\geq 100$ workers	859	5.7	258	1.9
Job satisfaction				
Yes	11015	73.5	10438	75.3
No	3964	26.5	3421	24.7
Authority to working schedule				
Possible	8659	57.8	7558	54.5
Impossible	6320	42.2	6301	45.5
Shift work				
Yes	1315	8.8	801	5.8
No	13664	91.2	13058	94.2
Regularity of the commute				
Yes	10902	72.8	10872	78.4
No	4077	27.2	2987	21.6
Income (million, KRW)				
$\leq 12$	2499	16.7	4645	33.5
$\leq 20$ and $> 12$	3939	26.3	5652	40.8
$\leq 30$ and $> 20$	4733	31.6	2514	18.1
$> 30$	3808	25.4	1048	7.6

(59.2% vs. 51.5%, respectively). More than half of men (64.6%) and women (69.4%) had a contract of employment for less than one month. Furthermore, 56.3% of men and 63.7% of women reported working at a company with <10 workers. Most workers were satisfied with their job (73.5% in men and 75.3% in women). More men (25.4%) than women (7.6%) reported a salary of more than 30 million won (KRW).

Differences between men and women with and without sleep problems are shown in Table 2. Commute time, job satisfaction, and shift work were significantly associated with sleep problems in both men and women, as analyzed by the Chi-square test (men:  $P = 0.012$ ,  $<0.001$ , and  $<0.001$ ; women:  $P = 0.028$ ,  $<0.001$ , and  $0.013$ , respectively). In addition, in men, working hours ( $P = 0.025$ ) and income ( $P = 0.017$ ) were significantly related to sleep problems, whereas in women, lack of authority to self-determine a working schedule was associated with sleep problems ( $P = 0.002$ ).

Table 3 shows ORs and 95% CIs of the multivariate logistic regression model for sleep problems and occupational

characteristics in men and women. In both genders, long commute time (51–60 and > 60 minutes) showed an increased OR [men, 2.03 (CI = 1.32–3.13) and 2.05 (CI = 1.33–3.17); women; 1.58 (CI = 1.05–2.39) and 1.63 (CI = 1.06–2.50), respectively]. In men, long working hours showed an increased OR [1.41 (CI = 1.08–1.83)]. Workers expressing dissatisfaction with their job had a higher OR [men, 1.97 (CI = 1.58–2.46); women, 1.39 (CI = 1.12–1.72)] than those who expressed satisfaction. In addition, shift workers had a higher OR in both men [1.87 (CI = 1.37–2.56)] and women [1.46 (CI = 1.03–2.09)].

Lack of authority to working schedule for family life (individual life) is related to sleep problems in women, but not in men (OR = 1.35, 95% CI = 1.10–1.66 in women).

Fig. 1 displays the ORs and 95% CIs for commute time according to working hours ( $\leq 40$  and  $> 40$  hours/week). In men, long commute time (51–60 and > 60 minutes) showed an increased OR when working hours were  $> 40$  hours/week [2.08 (CI = 1.16–3.71) and 1.92 (CI = 1.08–3.41), respectively]. In addition, in women, long

**Table 2**  
Sex stratification of sleep problems according to study participant characteristics

Basic characteristics*	Men with sleep problems				P-value*	Women with sleep problems				P-value
	No		Yes			No		Yes		
	N	%	N	%		N	%	N	%	
Commuting time					0.012					0.028
$\leq 10$	2075	97.7	49	2.3		1901	96.9	61	3.1	
11–20	2918	97.7	69	2.3		3175	96.8	106	3.2	
21–30	2910	97.8	64	2.2		2903	97.2	83	2.8	
31–40	2433	97.7	57	2.3		2273	97.3	62	2.7	
41–50	924	97.3	26	2.7		819	96.2	32	3.8	
51–60	1544	96.4	57	3.6		1242	95.8	55	4.2	
>60	1789	96.5	64	3.5		1097	95.6	50	4.4	
Working hours (h)					0.025					0.069
$\leq 40$ hours	5968	97.8	136	2.2		6528	97	199	3.0	
>40 hours	8625	97.2	250	2.8		6882	96.5	250	3.5	
Period of employment					0.097					0.286
>1 year	4052	97.4	110	2.6		3447	96.6	121	3.4	
1 month–1 year	1136	96.5	41	3.5		646	95.8	28	4.2	
<1 month	9405	97.6	235	2.4		9317	96.9	300	3.1	
Company size					0.600					0.161
<10 workers	8223	97.6	205	2.4		8560	97.0	264	3.0	
11–50 workers	4230	97.3	117	2.7		3885	96.3	151	3.7	
51–100 workers	1306	97.1	39	2.9		715	96.5	26	3.5	
$\geq 100$ workers	834	97.1	25	2.9		250	96.9	8	3.1	
Job satisfaction					<0.001					<0.001
Yes	10800	98.0	215	2.0		10149	97.2	289	2.8	
No	3793	95.7	171	4.3		3261	95.3	160	4.7	
Authority to working schedule for family life (individual life)					0.522					0.002
Possible	8442	97.5	217	2.5		7346	97.2	212	2.8	
Impossible	6151	97.3	169	2.7		6064	96.2	237	3.8	
Shift work					<0.001					0.013
Yes	1253	95.3	62	4.7		12647	96.9	411	3.1	
No	13340	97.6	324	2.4		763	95.3	38	4.7	
Regularity of the commute					0.250					0.233
Yes	10631	97.5	271	2.5		10530	96.9	342	3.1	
No	3962	97.2	115	2.8		2880	96.4	107	3.6	
Income (million, KRW)					0.017					0.205
$\leq 12$	2423	97.0	76	3.0		4484	96.5	161	3.5	
$\leq 20$ and $> 12$	3838	97.4	101	2.6		5487	97.1	165	2.9	
$\leq 30$ and $> 20$	4637	98.0	96	2.0		2433	96.8	81	3.2	
>30	3695	97.0	113	3.0		1006	96.0	42	4.0	

\* P-value based on Chi-square tests.

**Table 3**  
Odds ratios and 95% confidence intervals for sleep problems according to occupational characteristics in men and women

Basic characteristics	Men		Women	
	OR	95% CI	OR	95% CI
<b>Commuting time</b>				
≤10	1.00	reference	1.00	reference
11–20	1.21	0.82–1.77	1.16	0.83–1.61
21–30	1.21	0.80–1.81	1.05	0.73–1.50
31–40	1.35	0.88–2.08	1.00	0.68–1.48
41–50	1.57	0.93–2.64	1.45	0.91–2.32
51–60	2.03	1.32–3.13	1.58	1.05–2.39
>60	2.05	1.33–3.17	1.63	1.06–2.50
<b>Working hours (h)</b>				
≤40 hours	1	reference	1	reference
>40 hours	1.41	1.08–1.83	1.25	0.97–1.61
<b>Period of employment</b>				
>1 year	1.00	reference	1.00	reference
1 month–1 year	1.31	0.86–2.00	1.32	0.83–2.11
<1 month	0.64	0.43–0.94	0.86	0.61–1.19
<b>Company size</b>				
<10 workers	1.00	reference	1.00	reference
11–50 workers	1.42	1.03–1.95	1.58	1.22–2.05
51–100 workers	1.65	1.07–2.54	1.41	0.90–2.20
≥100 workers	1.6	0.96–2.66	1.19	0.56–2.52
<b>Job satisfaction</b>				
Yes	1.00	reference	1.00	reference
No	1.97	1.58–2.46	1.39	1.12–1.72
<b>Authority to working schedule for family life (individual life)</b>				
Possible	1.00	reference	1.00	reference
Impossible	1.01	0.80–1.26	1.35	1.10–1.66
<b>Shift work</b>				
Yes	1.00	reference	1.00	reference
No	1.87	1.37–2.56	1.46	1.03–2.09
<b>Regularity of the commute</b>				
Yes	1.00	reference	1.00	reference
No	0.94	0.71–1.23	0.91	0.69–1.19
<b>Income (million, KRW)</b>				
≤12	1.00	reference	1.00	reference
≤20 and > 12	1.07	0.76–1.51	0.94	0.72–1.22
≤30 and > 20	0.88	0.61–1.28	1.07	0.77–1.48
>30	1.28	0.87–1.87	1.31	0.87–1.96

OR, odds ratio; 95% CI, 95% confidence interval.

commute time (41–50, 51–60, and >60 minutes) showed an increased OR when working >40 hours/week [2.40 (CI = 1.27–4.55), 2.28 (CI = 1.25–4.16), and 2.19 (CI = 1.17–4.16), respectively]. Moreover, in women, long commute time (>60 minutes) showed an increased OR when working ≤40 hours/week [1.96 (CI = 1.06–3.62)].

#### 4. Discussion

This large cross-sectional study highlights that long commute time is significantly associated with sleep problems in both genders. In addition, long commute time in association with long working hours increased the risk of sleep problems after adjustment for other work characteristics including employment period, company size, job satisfaction, authority to self-determine working schedule, shift work, regularity of commute, and income. In addition, gender-specific differences such as lack of authority to working schedule for family life (individual life) were investigated in relationship with working characteristics and sleep problems.

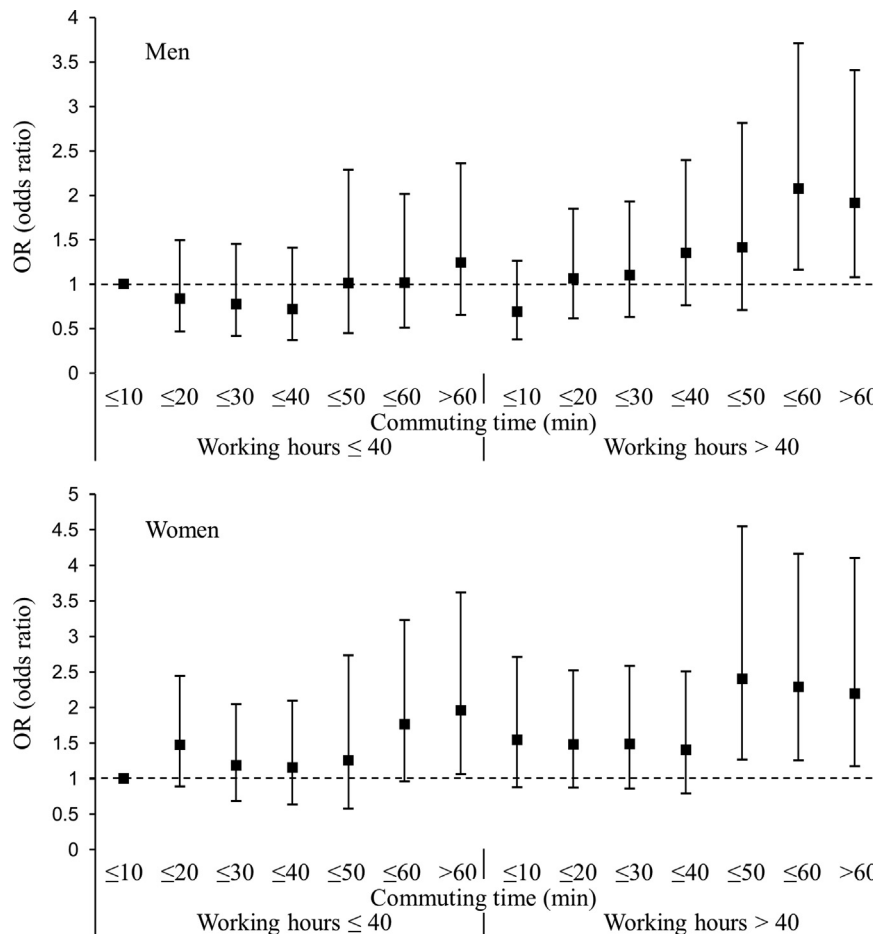
Compared with the sleep habits of other workers, workers with a long commute time of >60 minutes or overtime work (>40 hours/week) tend to sleep less on weekdays; consequently, sleep deprivation affects their activities on the following day [20]. Moreover, a study from the US suggests that workers spending more than 3 hours a day on commute time are more likely to exhibit fewer health-related problems [9]. Consequently, the work–life balance can be disrupted by long commute time. In the present study, commute times of Korean workers that were related to health problems were less than those reported in a US study. However, in the 2000s, annual working hours in the US ranged from 1762 to 1811, whereas those in Korea ranged from 2024 to 2209. Accordingly, the relationship of relatively shorter commute times with health problems in the present study may result from the longer working hours of Korean workers compared with those of US workers. Based on these points, it can be surmised that long commute time causes sleep deprivation, which in turn causes various health-related problems and a reduction in work productivity.

Nonetheless, previous studies [9,20] were insufficient to analyze the causes of sleep problems as they neither considered tandem variables such as working hours and commute time nor stratified results by gender. Hence, the current results provide new scientific evidence that can be used to prevent sleep problems resulting from a long commute time. Moreover, studies have investigated working hours and sleep problems but not the relationship between commute time and sleep problems in Korea.

Both men and women experience sleep problems with a long commute time of >50 minutes/day. However, the present study also shows a gender-specific difference: in workers working >40 hours/week, sleep problems occurred with a commute time of >50 minutes in men and >40 minutes in women; moreover, in workers working ≤40 hours/week, commute time was only a significant factor in women. This may be due to the traditional family role wherein women spend more time caring for family or engaging in household chores than men. Although there were dramatic changes in gender roles in family, women still have been assumed as primarily responsible for household chores [21]. Such a traditional gender role also affects the psychological problem such as depressive symptoms and suicidality. Family-care job is dependent more on women than on men in the Asian country. A study shows that long working hours of female spouses were linked to male spouses' psychological symptoms, but that relationship was weaker for male spouses' long working hours [22].

Long working hours may distribute time allocation, and such work-related schedules make workers hard to handle their own life; consequently, the so-called work–life balance is disrupted [17]. Work–life balance is associated with job and life satisfaction that is related to mental health [18]. In the same context, long commute time may relate to sleep disturbance in the present study, and it might explain the disrupted work–life balance.

Furthermore, the lack of authority to self-determine a working schedule was only related to sleep problems in women; this further supports our supposition of a traditional role of women influencing the relationship between working characteristics and sleep problems. However, owing to lack of information, we were unable to investigate this specific hypothesis. In addition, the current results suggest that if women are unable to adjust their working schedule to promote family life, they are more likely to experience sleep problems than men. In contrary, sleep problems in men, but not in women, were related to low income. Therefore, we considered that income is not a significant factor affecting sleep problems because sleep problems are mainly caused by physical fatigue such as long commute time rather than psychological effects caused by income. These results suggest that traditional gender roles in the family



**Fig. 1.** Relationship of commute time and working hours on sleep problems in men and women. The adjusted odds ratio (OR) for each stratum was compared with that for workers with a commute time of  $\leq 10$  minutes for each respective sex. The bar indicates the 95% confidence interval of estimates.

exist in Korea, and this contributes to different sources of stress in men and women [24]. Nevertheless, job satisfaction and shift work were closely related to sleep problems in both genders. For shift work, the sleep disturbance such as difficulty to sleep and shortened sleep occurs owing to circadian interferences [25].

The relationship between long commute time and sleep problems can be explained as a result of the psychological and physiological stress mechanism. First, long commute time reduces quality of life by decreasing leisure activities, interactions with family or friends, and engagement in hobbies [9]; consequently, there is a decreased opportunity to recover from daily stress: daytime distress and impairment are also related to sleep problems [26].

The main system modulating or continuing sleep is the hypothalamo–pituitary–adrenal (HPA) axis; therefore, impairments of this axis can promote various sleep problems [27,28]. Typically, stress can result in increase in cortisol levels and hyperactivity of the HPA axis and inhibit sleep. For workers, waking up early owing to a long commute time might be a stress source, resulting in sleep problems. In addition, the commute time to work may also contribute to physiological stress; for instance, although workers may be unaware, daytime traffic noise can be a stress source [29]. Moreover, daytime noise or vibration exposure initiates hyperarousal, which is linked to the HPA axis; such disruptions lead to difficulties in falling asleep, staying asleep, or experiencing non-restorative sleep [30–32]. In light of the present results, workers with long commute time and long working hours do not sleep well.

Our present study has some limitations. First, causality cannot be determined because of the nature of the cross-sectional design. In addition, there is a lack of mechanisms by which commute time may affect sleep. There are many risk factors related to sleep problems, such as obesity, obstructive sleep apnea, childcare, caffeine drinking in daytime, household environment, job stress of job demand, authority and social support, and noise [23].

We did not control those well-known risk factors of sleep problems, so the independent causality may be not discussed in the present study. Nonetheless, the dose–response relationship of commute time with sleep problems supports the concept that longer commute time aggravates sleep problems. Second, we used a self-reported questionnaire to define sleep problems. Although subjective health problems are an important public health issue, sleep problems are not well defined by other outpatient data or inpatient data; accordingly, a more objective study design is needed to clarify the relevance of subjective sleep problems. Third, there are various types of sleep problems, but this study only analyzed the presence or absence of sleep problems; therefore, there is a lack of insight into the association of commute time and working hours with specific sleep problems. Our data also have healthy worker survival effect that workers who suffer from severe sleep problems may quit or retire from the workplace. Hence, that healthy worker survival effect makes our analysis move toward null association, thus the so-called underestimation problem might occur. Furthermore, the relationship between commute time and sleep problems has been analyzed without considering how to

commute. Therefore, a lack of insight might occur because not only the commute time but also how to commute might be significant factors associated with sleep problems.

In summary, this study highlights that long commute time is related to sleep problems in both genders. In addition, gender-specific differences such as lack of authority to working schedule for family life (individual life) and interaction to long working hours are associated with sleep problems. Improved commute time and shorter working hours in the concept of work–life balance are needed to prevent sleep problems in workers.

## Declarations

### *Ethical approval and consent to participate*

The data used in this study did not have any personal information.

### *Availability of data and material*

The data sets analyzed during the present study are publicly available on the website after request. The URL is <https://www.kosha.or.kr>.

## Conflicts of interest

The authors declare that there is no conflict of interest.

## Funding

This study was supported by a faculty research grant of Yonsei University College of Medicine (6-2018-0175).

## Acknowledgments

The data of the present study are from the Korean Working Condition Survey (KWCS). The authors thank KOSHA for constructing the KWCS to investigate this study.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2019.08.001>.

## References

- [1] Dembe AE, Erickson JB, Delbos RG, Banks SM. The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States. *Occup Environ Med* 2005;62:588–97.
- [2] Spurgeon A, Harrington JM, Cooper CL. Health and safety problems associated with long working hours: a review of the current position. *Occup Environ Med* 1997;54:367–75.
- [3] Knutsson A. Health disorders of shift workers. *Occup Med* 2003;53:103–8.
- [4] Costa G. Shift work and health: current problems and preventive actions. *Safety Health Work* 2010;1:112–23.
- [5] Clarkson TW, Magos L, Myers GJ. The toxicology of mercury — current exposures and clinical manifestations. *N Engl J Med* 2003;349:1731–7.
- [6] Hassim MH, Hurme M. Occupational chemical exposure and risk estimation in process development and design. *Process Safety Environ Protect* 2010;88:225–35.
- [7] Jeong I, Park JB, Lee K-J, Won J-U, Roh J, Yoon J-H. Irregular work schedule and sleep disturbance in occupational drivers—a nationwide cross-sectional study. *PLOS One* 2018;13:e0207154.
- [8] Daley M, Morin CM, LeBlanc M, Grégoire JP, Savard J, Baillargeon L. Insomnia and its relationship to health-care utilization, work absenteeism, productivity and accidents. *Sleep Med* 2009;10:427–38.
- [9] Christian TJ. Trade-Offs between commuting time and health-related activities. *J Urban Health* 2012;89:746–57.
- [10] Gottholmseder G, Nowotny K, Pruckner GJ, Theurl E. Stress Perception and Commuting. *Health Econ* 2009;18:559–76.
- [11] Walsleben JA, Norman RG, Novak RD, O'Malley EB, Rapoport DM, Strohl KP. Sleep habits of long island rail road commuters. *Sleep* 1999;22:728–34.
- [12] Bohle P, Quinlan M, Kennedy D, Williamson A. Working hours, work-life conflict and health in precarious and "permanent" employment. *Rev Saude Publ* 2004;38:19–25.
- [13] Lyons G, Chatterjee KA. Human perspective on the daily commute: costs, benefits and trade-offs. *Trans Rev* 2008;28:181–98.
- [14] Virtanen M, Ferrie JE, Gimeno D, Vahtera J, Elovainio M, Singh-Manoux A, et al. Long working hours and sleep disturbances: the whitehall II prospective cohort study. *Sleep* 2009;32:737–45.
- [15] Åkerstedt T, Fredlund P, Gillberg M, Jansson B. Work load and work hours in relation to disturbed sleep and fatigue in a large representative sample. *J Psychosom Res* 2002;53:585–8.
- [16] Kim BH, Lee HE. The association between working hours and sleep disturbances according to occupation and gender. *Chronobiol Int* 2015;32:1109–14.
- [17] Zheng CN, Molineux J, Mirshekary S, Scarparo S. Developing individual and organisational work-life balance strategies to improve employee health and wellbeing. *Empl Relat* 2015;37:354–79.
- [18] Haar JM, Russo M, Sune A, Ollier-Malaterre A. Outcomes of work-life balance on job satisfaction, life satisfaction and mental health: a study across seven cultures. *J Vocat Behav* 2014;85:361–73.
- [19] Team RC. R: a language and environment for statistical computing; 2018.
- [20] Kageyama T, Nishikido N, Kobayashi T, Kurokawa Y, Kaneko T, Kabuto M. Long commuting time, extensive overtime, and sympathodominant state assessed in terms of short-term heart rate variability among male white-collar workers in the tokyo megalopolis. *Ind Health* 1998;36:209–17.
- [21] Kroska A. Investigating gender differences in the meaning of household chores and child care. *J Marriage Fam* 2003;65:456–73.
- [22] Yoon JH, Kang MY. The crossover effect of spouses' long working hours on depressive symptoms and suicidal ideation. *Ind Health* 2016;54:410–20.
- [23] Åkerstedt T, Knutsson A, Westerholm P, Theorell T, Alfredsson L, Kecklund G. Sleep disturbances, work stress and work hours: a cross-sectional study. *J Psychosom Res* 2002;53:741–8.
- [24] Kim S. Gender differences in the job satisfaction of public employees: a study of seoul metropolitan government, Korea. *Sex Roles* 2005;52:667–81.
- [25] Åkerstedt T. Shift work and disturbed sleep/wakefulness. *Occup Med (Lond)* 2003;53:89–94.
- [26] Roth T. Insomnia: definition, prevalence, etiology, and consequences. *J Clin Sleep Med: JCSM: Off Publ Am Acad Sleep Med* 2007;3:S7–10.
- [27] Buckley TM, Schatzberg AF. On the interactions of the hypothalamic-pituitary-adrenal (HPA) Axis and sleep: normal HPA Axis Activity and circadian rhythm, exemplary sleep disorders. *J Clin Endocrinol Metabol* 2005;90:3106–14.
- [28] Chrousos GP. Stress and disorders of the stress system. *Nat Rev Endocrinol* 2009;5:374.
- [29] Fruhstorfer B, Fruhstorfer H, Grass P. Daytime noise and subsequent night sleep in man. *Eur J Appl Physiol Occup Physiol* 1984;53:159–63.
- [30] Stepanski E, Zorick F, Roehrs T, Young D, Roth T. Daytime alertness in patients with chronic insomnia compared with asymptomatic control subjects. *Sleep* 1988;11:54–60.
- [31] Muzet A. Environmental noise, sleep and health. *Sleep Med Rev* 2007;11:135–42.
- [32] Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, et al. Auditory and non-auditory effects of noise on health. *Lancet* 2014;383:1325–32.