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## Original article

## Mediating Effect of Work–Family Conflict on the Relationship Between Long Commuting Time and Workers' Anxiety and Insomnia

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## ABSTRACT

**Background:** Our study aimed to investigate the mediating role of work–family conflict (WFC) on the relationship between long commutes and workers' anxiety and insomnia.**Methods:** Our study measured the two dimensions of WFC, time-related, and strain-related, which were considered multiple mediators. The mediating effect of WFC on anxiety and insomnia was investigated by decomposing the total effect into a direct effect (long commuting time → anxiety or insomnia) and an indirect effect (long commuting time → WFC → anxiety or insomnia). The combined indirect effect (joint indirect effect) of strain-related WFC and time-related WFC was estimated. The effects were presented as odds ratios and 95% confidence intervals (CIs).**Results:** The direct effect of 120 min or longer of commuting time was 1.39 (95% CI: 1.17–1.65) times increase in the odds of anxiety and 1.64 (95% CI: 1.41–1.90) times increase in the odds of insomnia than those whose commuting time was less than 60 min. In the case of indirect effects, those whose commuting time was 120 min or longer had 1.13 times higher odds of anxiety (95% CI: 1.07–1.18) and 1.12 times higher odds of insomnia (95% CI: 1.07–1.17) via WFC. The joint indirect effects accounted for 26.4% and 18.5% of the total effect on anxiety and insomnia, respectively. The longer the commuting time, the stronger both direct and indirect effects.**Conclusions:** Our findings highlight the mediating effect of WFC on the relationship between long commuting times and workers' anxiety and insomnia.© 2022 THE AUTHORS. Published by Elsevier BV on behalf of Occupational Safety and Health Research Institute, Korea Occupational Safety and Health Agency. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

In the last few decades, workers and companies have emphasized work-life balance. The negative interaction between work and life, namely work–family conflict (WFC), occurs when individuals consume too many resources (e.g., energy and time) for their role as professionals or family members such that they feel that it is difficult to properly fulfill the other role [1]. Numerous studies have investigated the consequences of WFC. WFC induces role stress, leading to burnout and emotional exhaustion of workers [2,3]. Consequently, prolonged exposure to role conflict eventually

causes a deterioration of psychological health. According to the conservation of resources theory, workers who have exhausted their personal resources due to WFC could fall into the status of psychological distress and strain [4]. From this perspective, previous cross-sectional and prospective studies have consistently reported that emotional exhaustion due to WFC is closely related to workers' mental health problems [2,5–8]. For example, multiple studies have found that increased WFC was associated with anxiety symptoms [7,8] and insomnia [9–11]. Additionally, previous studies have revealed a significant association between WFC and depression [12] and suicidal ideation [13].

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Abbreviations: WFC, work-family conflict; KWCS, Korean Working Conditions Survey.

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E-mail address: [juwon@yuhs.ac](mailto:juwon@yuhs.ac) (J.-U. Won).2093-7911/\$ – see front matter © 2022 THE AUTHORS. Published by Elsevier BV on behalf of Occupational Safety and Health Research Institute, Korea Occupational Safety and Health Agency. 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.2022.11.003>

Commuting is one of the major factors influencing work–family balance. Workers' commuting time is determined by the conditions of their professional (e.g., job, salary) and personal life (e.g., number of family members, age of the youngest child) [14]. Although reductions in commuting time have recently been observed as governments and companies encourage employees to work from home during the COVID-19 outbreak [15], commuting times in both Western and Eastern countries have increased in the last few decades due to the process of urbanization [16,17]. While accumulated years of commuting involving physical activity have a protective effect by reducing cardiovascular disease risk and cancer mortality [18,19], excess commuting time can lead to poor subjective health [20], risky health behaviors [21], and obesity [22].

Studies have been conducted on the effect of long commuting times on workers' mental health. Some researchers have found an association between a longer commuting time and depression [23], increased stress [24], and poor sleep quality [25]. Several factors have been identified as the causes of adverse effects of long commutes. For instance, accumulated fatigue due to prolonged commuting causes the deterioration of workers' mental health [26]. In addition, a previous study maintained that frequent traffic jams while using a car for commuting contributed to an overall increase in stress [23]. In addition, long commuting times not only cause mental strain but also increase worker time pressure. A long commute can reduce the amount of time workers spend with their family members or do housework before and after work [27].

However, even though a long commute is an important trigger for WFC and WFC affects workers' mental health, this association has been ignored in the literature. In other words, a long commuting time can directly cause poor mental health by inducing fatigue and stress in workers while indirectly contributing to mental health deterioration by inducing WFC.

Thus, our study is the first to investigate the mediating role of WFC on the relationship between long commutes and workers' anxiety and insomnia. Workers' anxiety and insomnia not only result in depression or suicidal thoughts/behavior but are also associated with economic costs for nations and companies by lowering work performance [28,29]. Our findings could provide valuable information to develop policies that protect workers' mental health.

## 2. Materials and methods

### 2.1. Study samples

We used data from the sixth Korean Working Condition Survey for this study. Since 2006, the Occupational Safety and Health Research Institute has conducted its nationwide KWCS to collect information regarding Korean workers' working environments and health. The sixth KWCS was conducted for six months, from October 2020 to April 2021, using a one-on-one survey by trained interviewers. A total of 50,538 participants were sampled using a probability-proportional-to-size sampling method based on the 2018 population and housing census conducted by Statistics Korea. Thus, the study sample represents economically active workers aged 15 years or older in South Korea.

Of the initial 50,538 survey participants, we limited our sample to 37,059 individuals aged 19–59 years since 60 is the retirement age in Korea. We excluded those who lived alone (7,171 participants) because the characteristics and effect of WFC of those living alone may differ from those living with other family members. Next, those who worked from home (1,276 participants) were excluded because commuting time cannot be calculated in this case. After excluding those with missing values (2,781

participants), we were left with 25,831 final study samples. Fig. S1 depicts the flowchart of study participants selection.

### 2.2. Data availability statement

The KWCS data used in this study are available online (<https://www.kosha.or.kr/eoshri/resources/KWCSDownload.do>).

### 2.3. Ethics statement

The KWCS data do not contain personal information. All the survey participants provided informed consent. The Institutional Review Board of Yonsei Health System approved our study (approval number: 4-2022-0805).

### 2.4. Main variables

#### 2.4.1. Commuting time

Survey participants were asked to answer the following question: 'In total, how many minutes per day do you usually spend traveling from home to work and back?' Commuting time was classified as < 60 min, 60–119 min, and ≥120 min. In the sensitivity analyses, commuting time was included as a continuous variable. In sensitivity analyses, the effect of a 60-min increase in commuting time was analyzed.

#### 2.4.2. WFC

Previous literature on WFC has separated it into two aspects. One is a time-related WFC, and the other is a strain-related WFC [30]. In line with the theoretical framework, our study measured the two dimensions of WFC, time-related and strain-related, which were considered mediators in our model. The survey questionnaire was originally developed by the researchers of the European Working Condition Survey and KWCS benchmarked it. Questionnaire development went through a thorough review by an expert group consisting of researchers in occupational safety and health and representatives of international organizations and labor unions. Before the finalization of the questionnaire, a pre-test was performed to validate the questionnaire [31]. Also, the questionnaire in this study has been widely used in multiple studies on WFC, which were based on European Working Condition Survey or KWCS [32–34].

The questions were as follows: 'How often in the last 12 months (or since you started your job) have you felt too tired after work to do some of the household jobs that need to be done' (strain-related WFC) and 'How often in the last 12 months (or since you started your job) have you found that your job prevented you from giving the time you wanted to your family' (time-related WFC). For each question, respondents answered based on a 5-point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = most of the time, 5 = always). Each WFC factor was included as a continuous variable in the analysis. Cronbach's alpha between time-related WFC and strain-related WFC was 0.83, and each variable was treated as a separate mediator.

#### 2.1.3. Mental health outcomes

Regarding workers' anxiety, survey participants were asked, 'Over the last 12 months, did you have anxiety?' They responded with 'yes' or 'no' to the question. Respondents who answered 'yes' were classified as having anxiety.

The Minimal Insomnia Symptom Scale was used to classify insomnia [35]. It consists of the following three items regarding sleep quality: (1) difficulty falling asleep, (2) night awakenings, and (3) not being rested after sleep. Each item was measured as 0 = never, 1 = rarely, 2 = several times a month, 3 = several times a

week, and 4 = daily. The total scores ranged from 0 to 12. According to previous studies,  $\geq 6$  was defined as having clinically significant insomnia [35].

We treated health outcomes as binomial variables because we focused on the impact on clinically significant outcomes. Therefore, the associations were expressed as the odds ratios (ORs) to make our findings more clinically interpretable.

#### 2.4.4. Covariates

Our model controlled for individual-level sociodemographic characteristics including age, sex, education level ('college,' 'high school or lower'), marital status ('married,' 'unmarried or others'), monthly income (log-transformed), occupation ('white collar,' 'blue collar'), and working hours per week. Occupations were classified in accordance with the Korean Standard Classification of Occupations.

#### 2.5. Statistical analysis

In the descriptive analyses, socioeconomic characteristics, prevalence of outcomes, and WFC-related factors were compared according to commuting time. The Chi-square  $p$ -value for the categorical variable represents the statistical significance of the distribution difference of each characteristic according to commuting time. Next, we used multivariate linear/logistic regression models to determine whether there was a significant association between the two indirect paths (long commuting time  $\rightarrow$  WFC and WFC  $\rightarrow$  outcomes). Thus, the following associations of commuting time, WFC, and anxiety and insomnia were explored: (i) the association of commuting time and WFC (long commuting time  $\rightarrow$  WFC) and (ii) the association of WFC and anxiety and insomnia (WFC  $\rightarrow$  outcomes).

Based on the association of WFC with commuting time and outcome, we performed multiple mediation analysis using the method suggested by Buis [36]. The Stata package *ldecomp* was designed to estimate the joint indirect effects of multiple mediators in the logit model. The mediating effect of WFC on anxiety and insomnia was investigated by decomposing the total effect into a direct effect (long commuting time  $\rightarrow$  anxiety or insomnia) and an indirect effect (long commuting time  $\rightarrow$  WFC  $\rightarrow$  anxiety or insomnia). The combined indirect effect (joint indirect effect) of strain-related WFC and time-related WFC was estimated. Mental

health outcomes (anxiety and insomnia) were included as binomial variables, and the effects were presented as ORs. Additionally, the joint indirect effect of WFC factors on the relationship between commuting time and outcomes was estimated using a bootstrapping procedure with 5000 resamples, and 95% confidence intervals (CIs) were calculated. The proportion mediated was calculated by dividing the indirect effect by the total effect and presented as a percentage (%). Our multiple mediation model is shown in Fig. 1.

To test the robustness of our study, commuting time was included as a continuous variable in the sensitivity analysis; the results are presented in the [Supplementary Material](#). In the sensitivity analysis, we explored how an increase in the unit of 60 min of commuting time affects workers' anxiety and insomnia. In the sensitivity analyses, the R package *mma* was used to estimate the total, direct, and indirect effects [37]. Furthermore, the *mma* package provides an estimation of each indirect effect of individual mediators as well as the joint indirect effects. Statistical significance was defined as  $p < 0.05$ . Stata (version 16.0; StataCorp LLC, College Station, TX, USA) and R (version 4.2.1; R Foundation for Statistical Computing, Vienna, Austria) were used to perform the statistical analyses.

### 3. Results

Table 1 shows the distribution of the socioeconomic features of the study samples according to the groups separated by commuting time. The mean commuting time was 44.0 min. Of the total workers, 18,786 (72.7%) workers had a commuting time of less than 60 min, 5285 (20.5%) workers had a commuting time of 60–119 min, and 1760 (6.8%) workers had a commuting time of 120 min or longer. The mean age and proportion of females compared to males tended to decrease as commuting time increased. For example, the proportion of males and females in the group with less than 60 minutes of commuting time was 42.3% and 57.7%, respectively, while in the group with more than 120 minutes, men accounted for 61.8% and women 38.2% ( $p < 0.001$ ). Regarding socioeconomic factors, 73.8% of those whose commuting time was 120 min or more graduated from college, while only 57.3% of those whose commuting time was less than 60 min ( $p < 0.001$ ). In addition, the mean monthly income and proportion of white-collar workers increased as commuting time increased. In contrast, those who had

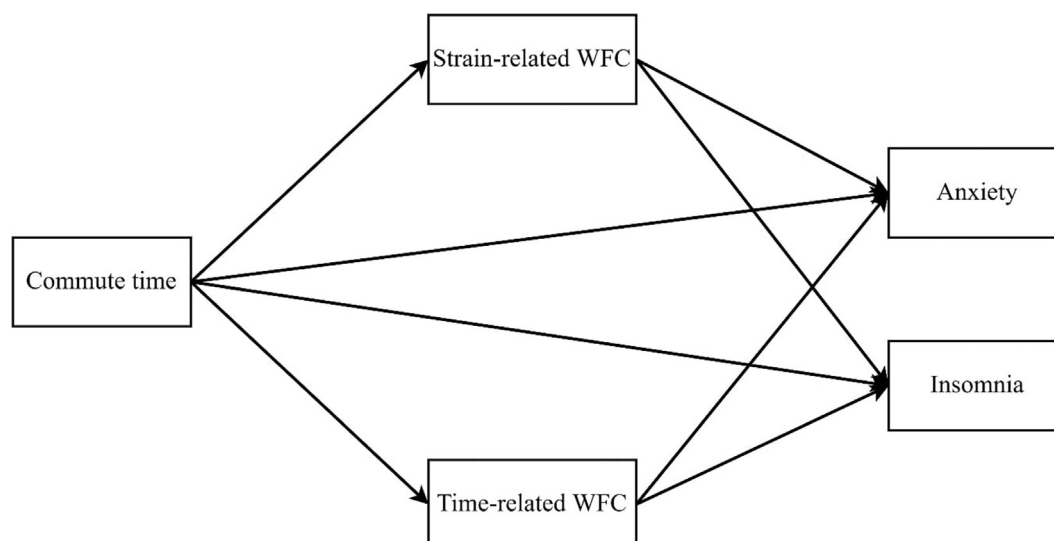


Fig. 1. Multiple mediation model of the effect of work–family conflict on the relationship between long commute time and anxiety and insomnia. [WFC: Work–Family Conflict].

**Table 1**  
Distribution of the sociodemographic characteristics of the study sample

Characteristics	Total workers N = 25,831 (%)	Commute time			p value*
		<60 min N = 18,786 (%)	60–119 min N = 5285 (%)	≥120 min N = 1760 (%)	
Commute time (min, mean ± SD)	44.0 ± 33.8	28.3 ± 12.2	68.6 ± 13.1	138.7 ± 35.6	<0.001
Age (mean ± SD)	43.8 ± 10.1	44.2 ± 10.2	42.9 ± 9.8	42.2 ± 9.8	<0.001
Sex					
Male	11,907 (46.1)	7944 (42.3)	2875 (54.4)	1088 (61.8)	<0.001
Female	13,924 (53.9)	10,842 (57.7)	2410 (45.6)	672 (38.2)	
Education					
College	15,724 (60.9)	10,759 (57.3)	3666 (69.4)	1299 (73.8)	<0.001
High school or lower	10,107 (39.1)	8027 (42.7)	1619 (30.6)	461 (26.2)	
Marital status					
Yes	19,589 (75.8)	14,385 (76.6)	3957 (74.9)	1247 (70.9)	<0.001
Others	6242 (24.2)	4401 (23.4)	1328 (25.1)	513 (29.1)	
Income (10,000 ₩, mean ± SD)	291.7 ± 144.3	280.0 ± 139.4	318.1 ± 149.6	337.7 ± 159.1	<0.001
Occupation					
White collar	19,448 (75.3)	14,039 (74.7)	4010 (75.9)	1399 (79.5)	<0.001
Blue collar	6383 (24.7)	4747 (25.3)	1275 (24.1)	361 (20.5)	
Working hour (mean ± SD)	42.6 ± 12.0	42.9 ± 12.6	42.1 ± 10.1	40.8 ± 9.4	<0.001

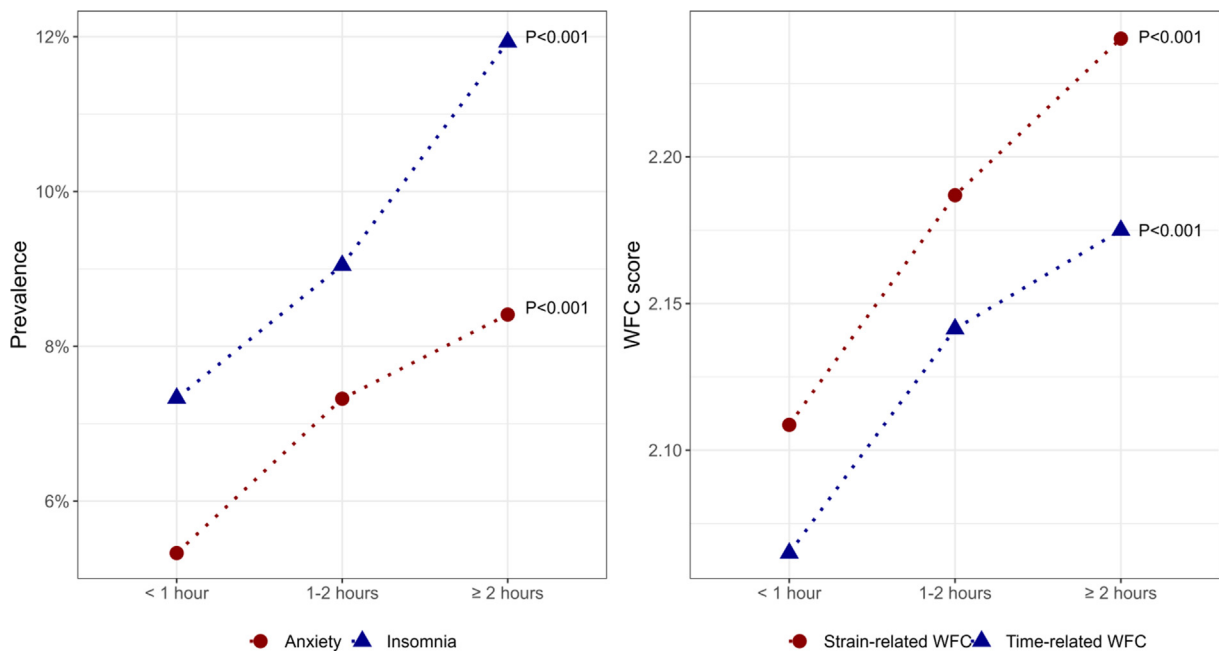
SD, standard deviation.  
\* Anova or Chi-square test.

long commuting times had fewer weekly working hours than those who had short commuting times.

Fig. 2 presents the prevalence of the outcomes and scores for strain- and time-related WFC among the study participants. The highest prevalence of anxiety was observed among those whose commuting time was 120 min or longer (8.4%) compared to those whose commuting time was 60–119 min (7.3%) and shorter than 60 min (5.3%). A similar trend was observed for insomnia, for which the highest prevalence was observed among those whose commuting time was 120 min or longer (11.9%) compared to those whose commuting time was 60–119 min (9.0%) and less than 60 min (7.3%). Regarding the participants' frequency of strain- and

time-related WFC, the longer the commuting time, the higher the WFC score.

Table 2 shows the association between commuting time and WFC (Model A, Model B) and between WFC and anxiety and insomnia (Model C, Model D). Compared to those whose commuting time was shorter than 60 min, a longer commuting time was associated with an increase in the frequency of both strain- and time-related WFC. For instance, a commuting time of ≥120 min was related to a 0.19-point increase in strain-related WFC score and a 0.17-point increase in time-related WFC. In addition, a significant relationship was observed between WFC factors and outcomes (anxiety and insomnia). A 1-point increase in strain-



**Fig. 2.** Work–family conflict and prevalence of anxiety and insomnia by commuting time. p values indicate the statistical significance of the trend [WFC: Work–Family Conflict].

**Table 2**  
Association of commuting time with work–family conflict and of work–family conflict with anxiety and insomnia

	Model A		Model B		WFC factors	Model C		Model D	
	Commute time → Strain-related WFC		Commute time → Time-related WFC			WFC → Anxiety		WFC → Insomnia	
	$\beta$	95% CI	$\beta$	95% CI		OR	95% CI	OR	95% CI
Commute time									
<60 min	0.00	Reference	0.00	Reference	Continuous variables				
60–119 min	0.11	0.08–0.14	0.10	0.07–0.13	Strain-related WFC	1.72	1.61–1.85	1.67	1.57–1.77
≥120 min	0.19	0.15–0.24	0.17	0.12–0.22	Time-related WFC	1.43	1.33–1.53	1.44	1.35–1.53

SE, standard error; CI: Confidence interval; OR: Odds ratio; WFC: Work–family conflict.

related WFC score was associated with higher odds of anxiety (OR [95% CI]:1.72 [1.61–1.85]) and insomnia (OR [95% CI]:1.67 [1.57–1.77]). Similarly, a 1-point increase in time-related WFC scores was associated with higher odds of anxiety (OR [95% CI]:1.43 [1.33–1.53]) and insomnia (OR [95% CI]:1.44 [1.35–1.53]).

Table 3 presents the total, direct, and joint indirect effects of long commuting times on anxiety and insomnia. The total effect of 60–119 min of commuting time on anxiety resulted in a 1.37-times increase in the odds (95% CI: 1.21–1.55) and that on insomnia resulted in a 1.32-times increase (95% CI: 1.18–1.48). Moreover, 60–119 min of commuting time was directly related to an increased risk of anxiety (OR [95% CI]: 1.28 [1.14–1.45]) and insomnia (OR [95% CI]: 1.24 [1.12–1.38]). In the case of indirect effects, those whose commuting time was 60–119 min had 1.07 times higher odds of anxiety (95% CI: 1.04–1.10) and 1.07 times higher odds of insomnia (95% CI: 1.04–1.10) via WFC. The joint indirect effect of strain- and time-related WFC mediated 20.9% and 22.8% of the effect of 60–119 min of commuting time and anxiety and insomnia, respectively. For those whose commuting time was 120 min or longer, both direct and indirect effects became stronger. The direct effect of 120 min or longer of commuting time was 1.39 (95% CI: 1.17–1.65) times increase in the odds of anxiety and 1.64 (95% CI: 1.41–1.90) times increase in the odds of insomnia. In the case of indirect effects, those whose commuting time was 120 min or longer had 1.13 times higher odds of anxiety (95% CI: 1.07–1.18) and 1.12 times higher odds of insomnia (95% CI: 1.07–1.17) via WFC. The joint indirect effects of strain- and time-related WFC accounted for 26.4% and 18.5% of the total effect on anxiety and insomnia, respectively.

Our sensitivity analysis (Table S1) revealed the same association as the main findings. The direct effect of a 60-min increase in commuting time was 1.24 (95% CI: 1.16–1.37) times increase in the odds of anxiety and 1.30 (95% CI: 1.20–1.40) times increase in the odds of insomnia. The joint indirect effect of strain- and time-

related WFC was 1.10 (95% CI: 1.06–1.15) times increase in the odds of anxiety and 1.10 (95% CI: 1.06–1.14) times increase in the odds of insomnia. The joint indirect effect accounted for 31.1% and 26.9% of the total effect, respectively.

#### 4. Discussion

To the best of our knowledge, this study is the first to reveal the mediating role of WFC in the relationship between long commuting time and anxiety and insomnia. A commuting time of 60 min or more is associated with frequent WFC, which, in turn, results in workers' anxiety and insomnia. In our study sample, the proportion of workers with more than two hours of commute was relatively small (6.8%). Nevertheless, both direct and indirect effects become strong for them. Therefore, we also found a dose-response relationship between commuting time and outcomes. In other words, both the direct and indirect effects of commuting time on anxiety and insomnia increase as workers spend more time commuting. Our findings reveal that long commuting times not only affect workers' anxiety and insomnia directly but also indirectly by inducing frequent WFC.

As Table 1 shows, workers may respond to increased commuting times by reducing their working hours. Past studies have reported that long working hours were associated with increased WFC and risks of mental health problems [32,38]. However, the impact of commuting time on WFC and outcomes was still significant even after controlling for working hours in our findings. Also, we expect following in-depth studies to investigate whether working hours can act as an effect modifier for association between long commuting time and WFC and mental health problems.

Our results accord with previous findings that long commuting times have a detrimental effect on workers' health. For example, an increase in commuting time is associated with depression [23] and poor mental health [39]. In addition, our results correspond with

**Table 3**  
Total, direct, and joint indirect effect of long commuting time on anxiety and insomnia

	Total effect		Direct effect		Indirect effect		Proportion mediated	
	$\beta$ (SE)	OR (95% CI)	$\beta$ (SE)	OR (95% CI)	$\beta$ (SE)	OR (95% CI)	%	95% CI
<b>Anxiety</b>								
Commute time		Reference		Reference		Reference		
<60 min								
60–119 min	0.32 (0.06)	1.37 (1.21–1.55)	0.25 (0.06)	1.28 (1.14–1.45)	0.07 (0.02)	1.07 (1.04–1.10)	20.9	8.1–33.7
≥120 min	0.45 (0.09)	1.57 (1.31–1.88)	0.33 (0.09)	1.39 (1.17–1.65)	0.12 (0.02)	1.13 (1.07–1.18)	26.4	11.2–41.6
<b>Insomnia</b>								
Commute time		Reference		Reference		Reference		
<60 min								
60–119 min	0.28 (0.06)	1.32 (1.18–1.48)	0.22 (0.05)	1.24 (1.12–1.38)	0.06 (0.02)	1.07 (1.04–1.10)	22.8	9.8–35.8
≥120 min	0.61 (0.08)	1.83 (1.56–2.15)	0.50 (0.08)	1.64 (1.41–1.90)	0.11 (0.02)	1.12 (1.07–1.17)	18.5	10.3–26.8

OR (Total effect) = OR (Direct effect) \* OR (Indirect effect).

Proportion mediated = Indirect effect/Total effect.

SE, standard error; CI, confidence interval; OR, odds ratio.

previous findings that  $\geq 1$  h of commuting time is related to sleep problems [40]. However, contrary to a previous study showing that an increase in commuting time is not positively associated with anxiety after returning from work [41], our results suggest that long commuting times can directly affect workers' anxiety.

Long commuting times may directly affect anxiety and insomnia by causing excess fatigue and stress during travel from and to work. Previous studies have reported that long commuting hours are related not only to subjective feelings of fatigue [42] but also to changes in heart rate variability, which is an objective measure of fatigue [43]. In addition, an increase in commuting time is positively related to psychological stress, such as life dissatisfaction and time pressure [27]. Considering that excessive stress or fatigue is a major cause of anxiety disorder and sleep disturbance, it can be inferred that long commuting times directly induce stress or fatigue, thereby affecting mental health deterioration.

In addition, physiological mechanisms may explain the relationship shown in this study. Notably, Karan et al. reported that long school commuting times in adolescents affect the secretion of hormones that control emotions and sleep patterns [44]. Increased commuting time can trigger chronic overactivation of the hypothalamic-pituitary-adrenal axis [44], which is known to lead to the development of mental health problems, including anxiety disorder [45] and insomnia [46]. Currently, it is unclear whether these changes in the endocrine system are also observed in adults, but the physiological mechanisms may explain the effects of commuting time on anxiety and sleep disorders.

Along with the direct effect of long commuting time on anxiety and insomnia, we revealed an indirect path by which commuting time affects workers' mental health via WFC. Consistent with previous studies, long commuting time was associated with an increase in WFC. For instance, Bai et al. revealed that long commuting time is positively associated with WFC [47]. Additionally, an increase in workers' commuting time reduces the time they spend with their spouses, children, and friends [48]. An increase in commuting time may increase workers' fatigue and stress, preventing them from handling housework after returning home. In addition, an increase in commuting time forces workers to sacrifice their time spent with their families and the time they need to do housework. Our results also reveal that WFC is associated with anxiety and insomnia, which is consistent with the findings of previous studies [6,10,49–51]. Excessive fatigue or lack of time due to long commuting times may interfere with workers' family roles, leading to high levels of anxiety and insomnia [50]. Alternatively, workers may cope by reducing their sleep time to fulfill their role as family members, which may trigger poor sleep quality or anxiety [49].

Our findings suggest that policy interventions are needed to mitigate the adverse effects of commuting time on anxiety and sleep disturbance. In the current theoretical framework, commuting time is determined by multiple factors such as demographic features of an individual, occupational characteristics, public transportation facilities, or spatial structure of a city [52]. According to the previous study, improving public transportation and providing flexible work hours have been suggested as ways to reduce commuting times [53]. Reducing traffic congestion and increasing public transportation connectivity have a positive effect on workers' mental health [54]. In terms of cost-effectiveness, improvements in public transportation or motorway traffic flow can affect large populations despite the high cost. One study also reported that high work schedule flexibility reduces the impact of long commuting times on WFC [47]. Therefore, when considered in conjunction with our study, flexible working hours can affect both direct and indirect paths between long commuting times and workers' anxiety and insomnia. Another possible way to lessen the need for long commuting time is organizational support for local

housing for employees [53]. Additionally, childcare support policies can mitigate the impact of commuting time on workers' health [47]. In addition to commuting time, the commuting experience can also affect the mental health of workers [23,25]. Therefore, a holistic approach will be needed to improve worker's commuting satisfaction.

Our study had several limitations. First, our analysis did not consider possible confounders such as commuting mode or experience during commuting. In particular, workers use various modes, such as walking, bicycles, cars, buses, and subways, for commuting, and commuting modes not only affect commuting satisfaction [55] but also act as a moderating factor in the relationship between commuting time and mental health [25]. Furthermore, one previous study argued that traffic delay time, rather than uncongested commuting time, is associated with depression [23]. Second, mental health outcomes in this study were measured only by self-report. In the case of anxiety symptoms, a validated measurement tool for anxiety is needed in future research. Third, our study was based on cross-sectional surveys; thus, longitudinal studies are needed to clarify the temporal association. Also, when interpreting the results, it should be considered that nearly the three-quarters of total workers have less than one hour of commuting time. Therefore, the proportion of workers affected by the long commute time may be relatively small. Finally, since the measurement for each WFC was based on a single question, more diverse aspects of time- and strain-related WFC should be reflected through measurements consisting of multiple questions in the following studies [56].

Despite these limitations, our study has several strengths. First, our conclusions were based on a nationally representative sample. Unlike previous studies that included only samples from a specific city or occupation, this study has an advantage in terms of generalizability because we used a large sample of workers with various characteristics. Finally, our study is meaningful in that it revealed the mediating effect of WFC on the relationship between long commuting times and anxiety and insomnia for the first time.

## 5. Conclusion

Our findings highlight the mediating effect of WFC on the relationship between long commuting times and workers' anxiety and insomnia. WFC partially mediates the effect of long commuting times on anxiety and insomnia. One or more hours of commuting time not only directly affects workers' anxiety and insomnia but also indirectly affects it by inducing WFC. Policymakers should implement appropriate policies to reduce the impact of commuting time as well as its impact on WFC.

## Conflicts of interest

All authors declare no conflicts of interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2022.11.003>.

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