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보건학석사 학위논문

The role of work-family conflict  
in the relationship between long  
working hours and workers'  
depressive symptoms: gender-  
stratified analysis in South Korea

장시간 노동과 근로자의 우울 증상과의 관계에서  
일-가족 갈등의 역할: 성별층화 분석으로

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서울대학교 보건대학원  
환경보건학과 환경보건학전공  
이 가 린

# The role of work–family conflict in the relationship between long working hours and workers’ depressive symptoms: gender– stratified analysis in South Korea

지도 교수 김 승 섭

이 논문을 보건학석사 학위논문으로 제출함

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서울대학교 보건대학원  
환경보건학과 환경보건학전공  
이 가 린

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위 원 장     윤 충 식     (인)

부위원장     조 원 광     (인)

위     원     김 승 섭     (인)

# Abstract

## The role of work–family conflict in the relationship between long working hours and workers’ depressive symptoms : gender–stratified analysis in South Korea

Garin Lee

Department of Environmental Health Science

The Graduate School of Public Health

Seoul National University

**Introduction:** Both long working hours and work–family conflict are known to harm workers’ health. However, little empirical research has been conducted to explore how work–family conflict work on the relationship between long working hours and depressive symptoms. Therefore, a gender–stratified analysis was conducted to understand how work–family conflict might be related to the association between long working hours and depressive symptoms in Korean workers.

**Methods:** I analyzed the 6th Korean Working Conditions Survey (KWCS), which is the national representative dataset in South Korea. After restricting the study population to non–shift work wage workers whose weekly working time is over 40 hours per week, 20,282 were included in the final analysis. Three questions in the KWCS measured work–family conflict. Depressive symptoms were measured by WHO–5 well–being index. Baron and Kenny method, Sobel test, and mediation analysis by bootstrapping were used to estimate the mediation effect. Then, to assess effect

modification, I conducted stratified analyses by work–family conflict and the interaction effect between work–family conflict and long working hours was estimated with the P–value. All estimation was performed after adjusting for age, education level, families with children under 18, employment type, occupational classification, monthly income, and company size.

**Results:** The prevalence of long working hours (more than 52 hours per week) was 12.1% among male workers and 8.4% among female workers. The mediation effects in both genders were statistically significant by Baron and Kenny method, Sobel test, and mediation analysis by bootstrapping. Workers with both long working hours and work–family conflict had more depressive symptoms than workers without both long working hours and work–family conflict in males (PR: 1.70, 95% CI: 1.54, 1.89) and females (PR: 1.70, 95% CI: 1.49, 1.93).

**Conclusion:** Our findings suggest that work–family conflict acts as a mediator and moderator in the relationship between long working hours and depressive symptoms.

**Keyword:** Long working hours, Depressive symptoms, Work–family conflict, Mediation, Effect modification, Gender–stratification

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# 1. Introduction

## 1.1 Study background

### 1.1.1 Long working hours and workers' mental health

Long working hours have been a critical health issue, threatening workers' health and well-being. A growing body of evidence has documented that long working hours negatively influence workers' mental health [1–7]. For example, a cross-sectional study in the US reported that workers in the more extended working hours group had significantly more depressive and anxiety symptoms and worse sleep quality than those in the regular working hours group [5]. Likewise, a prospective cohort study of 3921 Australian workers found that long working hours may increase the risk of major depression symptoms [1].

Previous studies suggested several mechanisms regarding how long working hours are associated with depressive symptoms. In the physiological recovery mechanism, long working hours mean that one might have to put more effort into the work and have less time available for recovery. Several physiological processes, such as hormone secretion and the sympathetic nerve system, are thought to be disturbed by insufficient recovery and, finally, lead to problems in a person's physical and psychological health [8, 9]. Furthermore, it is well documented that excessive work hours are associated with unhealthy lifestyle factors, including smoking, drinking alcohol, and lack of exercise in another mechanism [10–12]. These two processes might coincide and work in combination, not mutually exclusive. This approach makes it difficult to understand the effects of long working hours on workers' health [13, 14].

South Korea is one of the top countries with the most extended working hours worldwide. According to the Organization for

Economic Cooperation and Development (OECD), Koreans worked 1915 hours per year (36.8 hours per week) in 2021, which was 1.2 months per year, more than the average working time of OECD countries [15]. Even though the government has been aggressively restricting working hours in Korea, it has never fallen below the top four since joining the OECD in 1996 [15, 16]. Accordingly, many studies have been conducted on the effects of long working hours on the mental health of Korean workers. Work-related stress, depressive symptoms, and suicidal ideation were reported by Korean workers who worked long hours [16–21].

### **1.1.2 Role of work–family conflict in the relationship between long working hours and workers' mental health**

One individual who works has both a work life and a family life. However, the boundary between the areas of the two lives might not be clear. Work–family conflict refers to how one maintains his or her well-being while performing both roles at work and at family appropriately. [22, 23] However, balancing work and family life is often challenging, and the imbalance of two lives creates work–family conflict. [24]

A growing body of literature has shown the association between work–family conflict and workers' mental health [25]. For example, work–family life conflict was strongly associated with employees' mental well-being [25–28]. Also, several studies demonstrated that work–family conflict was associated with poor mental health, such as stress, depressive symptoms, and anxiety [26–28].

Previous studies reported that long working hours and work–family conflict are important risk factors for depressive symptoms.[29–32] However, to our knowledge, few studies examined how these two factors are related to mental health outcomes together. Even a few studies that included both variables in the data analysis treated one as an independent variable and the other as a confounder [29, 30, 33]. However, these previous

analyses may not be appropriate considering that long working hours and work–family conflict could be entangled in a complicated way in their relationship with mental health outcomes [34, 35]. In the association between long working hours and mental health outcomes, work–family conflict could be explained as a mediator or effect modifier.

A mediator is a variable acting in the causal pathway between an exposure and an outcome [36]. Work–family conflict could be a relevant mediator in the pathway linking long working hours to mental health [37]. In other words, long working hours may rob workers' time to deal with family issues. Having less time for their families causes work–family conflict, resulting in workers' poor mental health.

On the other hand, work–family conflict could act as an effect modifier in the relationship between long working hours and depressive symptoms. An effect modifier is a variable influencing the strength or direction of the relationship between two variables [38]. Work–family conflict might differ from worker to worker depending on the resources available to the worker. The workers' stress level during the same working hours could be greater depending on the level of work–family conflict and amplify the association between long working hours and depressive symptoms. For example, if a worker needs to take care of a child for himself or herself, the stress that one gets is higher even with the same working hours than those with a helper [39–42].

Men's and women's roles at work and at home are expected to differ. Moreover, in Korea, they play vastly different roles according to cultural beliefs based on Confucianism. According to the Korean working condition survey (2020), workers were asked how often they participate in house chores. About 60% of women participated in housework every day, whereas only 25% of males answered that they do it daily [43]. The number of married women who work is gradually increasing, and women's economic activities are essential for the economic growth of the country and the improvement of household income. However, the changes in the

values of traditional gender roles cannot keep up with the changes in society [44–46]. Since the increase in women's social advancement affects not only the lives of women but also those of families, men also experience role conflicts between work and family [47, 48]. Therefore, work–family conflict is a critical issue in Korea.

Even though males and females share many experiences, there are considerable differences in what people did as children, how they lived, what their homes were like, and what their workplaces were. These distinctions might influence the job exposure relations and subsequent health. [49]

This perspective suggests that the association between long working hours and work–family conflict may differ by gender [50]. The traditional gender–role stereotype holds that the man is mainly accountable for the household income, and as a result, he has a more substantial value at work. On the other hand, the woman is supposed to be responsible for house chores and childcare. According to this, when a work–family conflict exists, women who are considered responsible for house chores can be more stressed than men because they accept it as a failure to fulfill their duty in the family [51].

Also, the culture of East Asia encourages males to spend more time on work to optimize the financial benefits to the family [52, 53]. Based on separating gender roles in the family, when men work overtime, it is “acceptable” for them to temporarily give up time with their families to take care of themselves. On the other hand, because women are responsible for taking care of their families, even if women work long hours, they still have to spend a large part of their time taking care of the house [53]. Therefore, this study investigated gender differences in the role of work–family conflict between long working hours and workers' depressive symptoms.

## 1.2 Literature review

Previous literature was searched in PubMed with related words for long working hours and workers' mental health. To find relevant literature in PubMed, the keywords were selected based on PubMed MeSH terms and prior knowledge frequently used in systematic reviews on long working hours and mental health [7, 54–56] (Supplementary Figure 1). A recent systematic review of long working hours and mental health was published in 2014, reviewing literature between 1995–2012 [7]. Bannai and Tamakoshi [7] reported that long working hours had significant adverse effects on most health outcomes, including all-cause mortality, circulatory disease, diabetes mellitus, metabolic syndrome, depressive state, anxiety, other psychological disorders, sleep condition, cognitive function, and health-related behavior. Because the 19 studies they reviewed did not include any Korean research, I selected 20 studies published on Korean workers from 2012 to 2022 in Korea.

Supplement Table 1 and Table 2 summarize previous studies investigating the relationship between long working hours and mental health, including depressive symptoms. These contain study design, independent and dependent variables, primary findings, and other covariates.

Two longitudinal studies [57, 58] and ten cross-sectional studies [6, 59–67] examined the association between long working hours and mental health, except for depressive symptoms. Long working hours were the primary exposure in ten studies [6, 57–61, 63]; The other two studies investigated the effects of long working hours on workers' mental health by considering variability in working time [62] and household income [64], respectively, as major exposures. All 12 studies reported that extended working hours were related to poor mental health outcomes. Mental health outcomes from nine studies included stress [6, 65], anxiety [62], suicidal mortality rate or suicidal ideation [6, 57, 63, 67], sleep disorder or sleep duration [59, 66], unhealthy behaviors [58], cognitive function [60], psychological well-being [61], and self-

rated health [64]. Two of these studies also measured depressive symptoms concurrently with other variables [6, 62]. All studies reported that long working hours were negatively associated with workers' mental health. For example, long working hours were associated with higher suicide mortality rates but not with accident mortality in Korea[57]. Park and Kim [61] found that people who worked more than 52 hours per week were much more likely to have depression and anxiety symptoms than people who worked less than 40 hours per week. (Supplementary Table 1)

All eight studies were cross-sectional designs that investigated the relationship between long working hours and depressive symptoms. Six studies measured long working hours as the main exposure [4, 68–71], and two measured both working hours and work type [72]. All six studies showed that long working hours were associated with depressive symptoms. For example, Lee and Park [72] reported a significant association between long working hours and depression measured by CES-D. According to Choi, E. et al.[4], workers with excessive working hours were more likely to have moderate to severe depressive symptoms, especially prominent in female workers, standard wage workers, and low-income levels. (Supplementary Table 2)

Regarding work-family conflict, a literature review was conducted with the previous study, including keywords that affect long working hours and work-family conflict on mental health. When I searched for keywords indicating long working hours, work-family conflict, and mental health in PubMed (Supplementary Figure 2), a total of 55 studies were found. After excluding a study, not in English (n=1), review studies (n=6), and literature that was not matched in exposures or outcomes with this study (n=31), finally, seventeen studies were included in the literature review.

Supplementary Table 3 summarizes previous literature that examined long working hours, work-family conflict, and mental health. It contains the study design, independent and dependent variables measurements, main findings, and other covariates.

There were four longitudinal design studies and thirteen cross-

section studies. Two studies measured work–family conflict [48, 73] as the main exposure, and eight measured both work–family conflict and long working hours. However, all eight studies considered work–family conflict as one of the family characteristics and long working hours as one of the work characteristics. [29–31, 37, 74–77] These exposures had been reported to be associated with a variety of mental health outcomes, such as psychological distress [31, 32], depressive symptoms [29, 30, 37, 48, 77], sleep quality [74], life satisfaction [73, 75] and suicidal ideation [76]. For example, Sekine, M., et al. [74] reported that longer working hours and higher work–to–family conflict were linked to worse sleep quality. Long working hours were predictive of the persistence of major depression, and perceived work–family conflict was significantly associated with the recurrence of major depression. [32]

Five studies measured long working hours as an exposure and work–family conflict as a primary outcome [33, 78–81]. All five studies showed that long working hours were associated with work–family conflict. For example, working long hours were found to be a predictor of work–to–family conflict in both sexes [79]. Cooklin, A.R., et al. [78] reported that long and inflexible work hours were associated with increased work–family conflict, which was, in turn, associated with increased distress.

Eight studies reported gender disparities in mental health outcomes. [30, 33, 48, 73, 74, 77, 78, 80] Research showed contrary patterns to the observed results for mothers’ distress over childcare availability. Mothers experience more significant conflict than fathers in high–resource areas. But fathers who live in a childcare desert and work long hours reported more mental stress than fathers who did not live in a childcare desert. [33] And Frank, E., et al. [48] reported significant gender disparities in work and family experiences and mental health symptoms among physician parents during the COVID–19 pandemic.

According to previous studies, excessive work hours and work–family conflicts are significant risk factors for depressive



symptoms. [29–32] To our knowledge, few studies have explored the relationship between these two variables and mental health outcomes.[29, 30, 33] Because long working hours and work–family conflict may be intricately intertwined in their association with mental health outcomes, these earlier investigations may be insufficient.[34, 35]

## 1.3 Research aims

This study aimed to assess the role of work–family conflict in the relationship between long working hours and depressive symptoms after being stratified by gender.

- 1) Work–family conflict is a mediator between long working hours and depressive symptoms.
- 2) Work–family conflict is an effect modifier between long working hours and depressive symptoms.

## 2. Methods

### 2.1 Data and Study population

The data for the present study were from the Sixth Korean Working Conditions Survey (KWCS), conducted by the Occupational Safety and Health Research Institute (OSHRI) in 2020. The KWCS aims to identify work-related risk factors and provide representative statistics and primary data for improving Korea's occupational safety and health policies. The KWCS (2020) used a nationally representative sample, including economically active workers over 15 years old in Korea. The total sample size of the KWCS (2020) was 50,538. [82]

Among a total 50,538 individuals who participated in the KWCS, I excluded those who were self-employed or unpaid family workers ( $n=17,475$ ) or worked less than 40hrs per week ( $n=7,778$ ). I also excluded those who did shift work ( $n=2,629$ ) or had missing information ( $n=2,374$ ) on covariates, including work-family conflicts, depressive symptoms, and other covariates. As a result, 20,282 were included in the final analysis. (Figure 1)

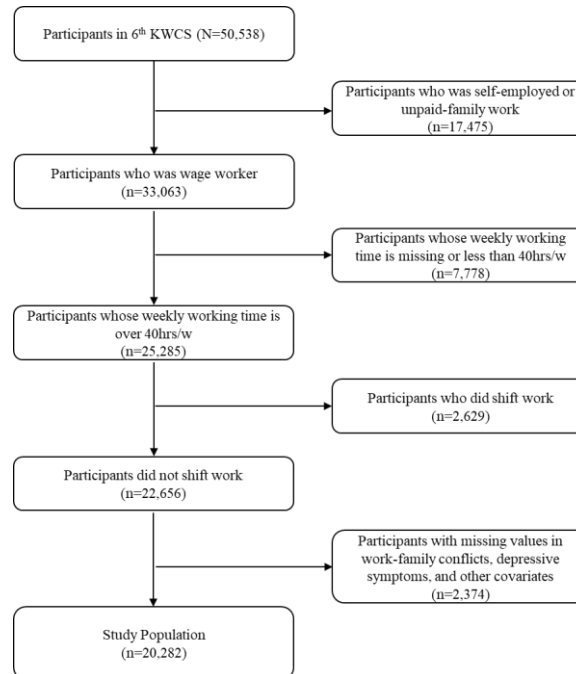


Figure 1. Flow diagram for study population from 6th KWCS.

## 2.2 Measures

### 2.2.1 Long working hours

Working hours were measured by the single question: “How many hours do you actually work at your workplace in a week?”. Weekly working hours were categorized into two groups according to the Korean Labor Standards Act as follows [83]: (1)  $\geq 40$ hrs and  $\leq 52$ hrs; (2)  $> 52$ hrs [83].

### 2.2.2 Work–family conflict

Work–family conflict was considered using participants' responses to the following three questions; (1) “How often in the last 12 months have you kept worrying about work when you were not working?”, (2) “How often in the last 12 months have you felt too tired after work to do some of the household jobs which need to be done?” and (3) “How often in the last 12 months have you found that your job prevented you from giving the time you wanted to your family?” Respondents could answer each question from 1 to 5 (1: always, 2: most of the time, 3: sometimes, 4: rarely, 5: never). The summed score ranged from 3 to 15. In this study, the work–family conflict score was classified into two categories: (1) “yes” or (2) “no,” and the median value 4 of the scale was used to determine the cut–off point of categorization.

### 2.2.3 Depressive symptoms

Depressive symptoms were measured using participants' responses from KWCS by the World Health Organization–Five Well–being index (WHO–5). WHO–5 is a short and generic global rating scale measuring subjective well–being and having adequate validity as a screening tool for depression. Since WHO–5 creation in 1998, it has been translated into more than 30 languages and used in research worldwide. When examining literature review articles on the validity of this instrument, it was determined that

this scale has adequate validity as a depression screening tool and outcome measuring tool in research, and it has been used in a wide range of research fields [84, 85]. The WHO-5 consist of five questions, and the sum score ranges from 0 to 25. WHO-5 uses a cut-off score of 13 points for depressive symptoms; accordingly, in WHO-5, a score of 13 or greater indicates depressive symptoms. Respondents were divided into two categories based on this criterion: (1)  $\geq 0$  and  $\leq 12$ ; (2)  $> 12$ .

## 2.2.4 Covariates

Sociodemographic variables included age (15–29, 30–39, 40–49, 50–59, and 60 or older; years), education level (elementary school, middle school, high school, and college graduate or higher), and children under age 18 years old in one's family (yes or no).

Occupational variables were employment type (permanent, temporary, or day), occupational classification (white-collar: manager, professionals, and office workers, pink-collar: service workers and sales workers, blue-collar: agricultural and fishery workers, skilled workers, machine operation and assembly workers, and simple labor workers), monthly income (199 or below, 200–299, 300–399, and 400 or above; based on 10,000 Korean Won), and company size (49 or less, 50–299, and 300 or more; the number of employees).

## 2.3 Data analysis

When there is a high prevalence of outcomes, odds ratios cannot be interpreted as risk ratios [86]. Because the prevalence of the outcome in this study was higher than 10%, modified Poisson regression with robust error variance (modified Poisson regression) was used to investigate the relationship between long working hours and work-family conflict with depressive symptoms after adjusting for age, education level, children in family, employment type, occupational classification, monthly income, and company size

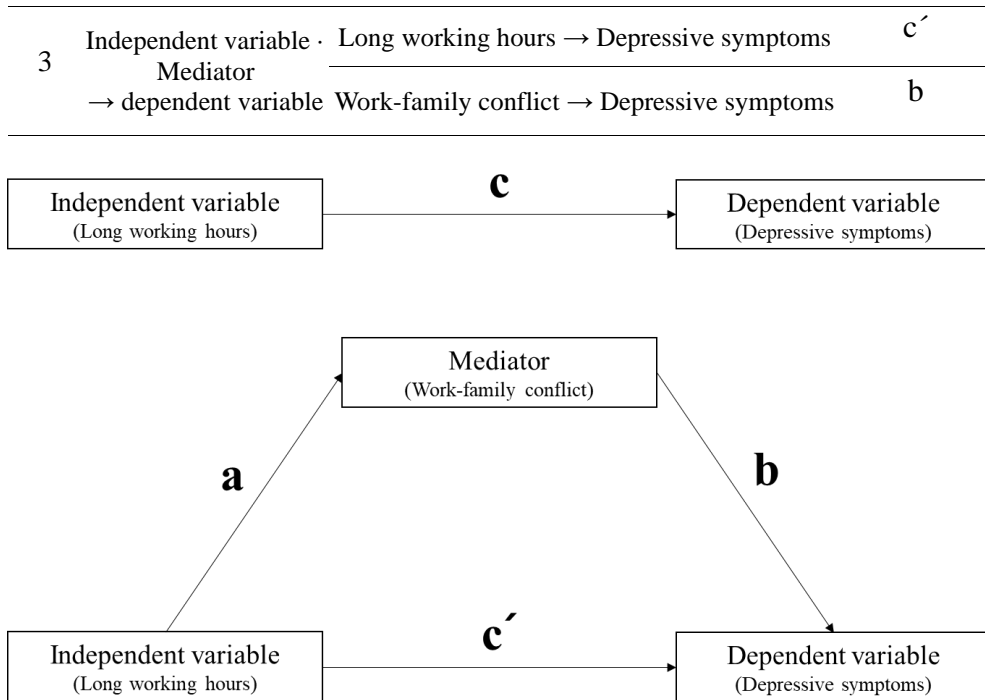
[87]. The prevalence ratio (PR) was estimated with 95% confidence intervals (CI).

To investigate whether the association differs by work–family conflict, I examined this variable's mediation and effect modification presence. In this study, to estimate mediation effects, I used the classical approach through parameters of Baron and Kenny method, Sobel test [88, 89], and the counterfactual approach through the indirect effect estimation using bootstrapping [90].

According to Baron and Kenny (1986), a three steps regression analysis approach is used to demonstrate the mediating effect. (Table 1, Figure 4) In the first step, it is determined whether the independent variable has a significant effect on the mediating variable(a). The second step verified whether the independent variable significantly affects the dependent variable(c). In the third step, it is verified whether the mediating variable has a significant effect on the dependent variable(b) when the independent variable and the mediating variable are input at the same time. Suppose the influence of the independent variable on the dependent variable in the third step (c') is no longer significant, the mediating variable is considered to have a complete mediating effect. On the other hand, if the influence of the independent variable in the third step (c') decreases but is still significant, it can be seen as indicating a partial mediating effect. Sobel test was then performed using the results of Baron and Kenny methods (a, b) [88, 89]. Finally, the indirect effect on the mediating effect was estimated through bootstrapping, a resampling–based regression analysis technique. Regarding previous studies, the basic number of bootstraps for the indirect effect model was analyzed as 1,000 [69].

**Table 1. Three steps of Baron and Kenny method**

	<b>Steps</b>	<b>variables</b>	<b>coefficient</b>
1	Independent variable → Mediator	Long working hours → Work-family conflict	a
2	Independent variable → dependent variable	Long working hours → Depressive symptoms	c



**Figure 2. Simplified diagram of mediation analysis.**

I conducted stratified analyses to assess the effect modification by gender and work–family conflict. Then, to examine the significance of effect modification on the multiplicative scale, the interaction effect between work–family conflict and long working hours was estimated with the P–value.

All statistical analyses were performed using STATA 17.0 SE (StataCorp., College Station, TX)

## 2.4 Ethics

The Institutional Review Board of Seoul National University approved this study (IRB No. E2211/001–005).

### 3. Results

Table 2 presents the distribution of the study population and the prevalence of long working hours, work–family conflict, and depressive symptoms by sociodemographic and work–related variables. The prevalence of long working hours was 12.0% in males and 8.4% in females, and that of depressive symptoms was 29.5% in males and 27.2% in females. The prevalence of long working hours among workers without children in their families (12.3% in males, 8.9% in females) was higher than that among those with children in their families (11.3% in males, 5.2% in females). And the prevalence of work–family conflict among workers without children (44.6% in males, 46.4% in females) was lower than that among those without children (36.8% in males, 40.6% in females). However, the difference in depressive symptoms' prevalence was not statistically significant between the two groups in both genders. The prevalence of long working hours was higher among male temporary employees (22.5%), and among female day employees (23.5%). And the prevalence of work–family conflict was higher among male day employees (41.0%) and female permanent employees (42.6%). However, the prevalence of depressive symptoms was higher among day employees in males (41.2%) and females (49.6%). Between the company size, the prevalence of work–family conflict was not different in males. However, the prevalence of work–family conflict among larger companies (50–299, over 300 employees) was higher than in smaller companies (1–49 employees).

Table 3 and table 4 verify the mediating effect of work–family conflict in the relationship between long working hours and workers' depressive symptoms using Baron and Kenny's method and bootstrapping. And Figure 2 is a diagram of it. Table 5 and 6 show the effect modification of work–family conflict in the relationship between long working hours and depressive symptoms.

As shown in Table 3 long working hours had a statistically significant effect on work–family conflict (males:  $PR=1.45$ ,

$p < 0.000$ ; females:  $PR = 1.22$ ,  $p < 0.000$ ) in step 1. Long working hours were found to have a statistically significant effect on workers' depressive symptoms (males:  $PR = 1.31$ ,  $p < 0.000$ ; females:  $PR = 1.34$ ,  $p < 0.000$ ) in step 2. When long working hours and work–family conflict were simultaneously inputted in step 3, long working hours appeared to be statistically significance on depressive symptoms (males:  $PR = 1.24$ ,  $p < 0.000$ ; females:  $PR = 1.30$ ,  $p < 0.000$ ), but it decreased compared to step 2, resulting in long working hours and depressive symptoms. It was found that work–family conflict partially mediated the relationship between the long working hours and depressive symptoms. Sobel test and bootstrapping were conducted to verify the statistical significance of the mediating effect. The Z value of the Sobel test was 22.91 in males ( $p < 0.000$ ) and 19.65 in females ( $p < 0.000$ ), indicating that the partial mediating effect of work–family conflict in the relationship between long working hours and depressive symptoms was statistically significant. The indirect effect, direct effect, and total effect of work–family conflict on the relationship between long working hours and depressive symptoms were statistically significant by analyzing the mediating effect through bootstrapping in both genders. (Table 4)

After being stratified by work–family conflict, the prevalence rate of depressive symptoms was higher in long working hours than in no long working hours. (Table 5) In males, the prevalence rates of depressive symptoms were 1.24 in long working hours without work–family conflict and 1.23 those with work–family conflict. Moreover, in females, the prevalence rates of depressive symptoms were 1.26 in long working hours without work–family conflict and 1.33 in those with work–family conflict. Table 6 presents the prevalence rate of depressive symptoms for only long working hours group (males: 1.26, females: 1.36), for only work–family conflict group (males: 1.39, females: 1.36), and for both long working hours and work–family conflict group (males: 1.70, females: 1.70), where no long working hours and no work–family conflict group is the referent.



Table 2. Distribution of the long working hours, work–family conflict, and depressive symptoms by key covariates among study population (n=20,282)

	Distribution		Long working hours				Work-family conflict				Depressive symptoms			
	Male	Female	Male		Female		Male		Female		Male		Female	
	N (%)	N (%)	N (%)	P-value <sup>a</sup>	N (%)	P-value <sup>a</sup>	N (%)	P-value <sup>b</sup>	N (%)	P-value <sup>b</sup>	N (%)	P-value <sup>c</sup>	N (%)	P-value <sup>c</sup>
<b>Total</b>	10334 (100)	9948 (100)	1236 (12.0)		864 (8.4)		4069 (39.4)		4207 (40.7)		3045 (29.5)		2814 (27.2)	
<b>Age (years)</b>			0.000		0.000		0.000		0.000		0.000		0.000	
15-29	1298 (12.6)	1227 (12.3)	223 (17.2)		92 (7.5)		455 (35.1)		442 (36.0)		306 (23.6)		315 (25.7)	
30-39	2776 (26.9)	2409 (24.2)	305 (11.0)		138 (5.7)		1097 (39.5)		1055 (43.8)		781 (28.1)		629 (26.1)	
40-49	2936 (28.4)	2656 (26.7)	355 (12.1)		153 (5.8)		1259 (42.9)		1189 (44.8)		880 (30.0)		728 (27.4)	
50-59	2210 (21.4)	2695 (27.1)	232 (10.5)		264 (9.8)		883 (40.0)		1155 (42.9)		694 (31.4)		778 (28.9)	
60-	1114 (10.8)	961 (9.7)	121 (10.9)		132 (13.7)		375 (33.7)		366 (38.1)		384 (34.5)		364 (37.9)	
<b>Education level</b>			0.000		0.000		0.000		0.000		0.000		0.000	
Elementary school or less	96 (0.9)	178 (1.7)	11 (11.5)		27 (15.2)		34 (35.4)		60 (33.7)		50 (52.1)		90 (50.6)	
Middle school	312 (3.0)	390 (3.8)	49 (15.7)		60 (15.4)		106 (34.0)		141 (36.2)		129 (41.3)		159 (40.8)	
High school	3112 (30.1)	3296 (31.9)	603 (19.4)		431 (13.1)		1152 (37.0)		1345 (40.8)		1097 (35.3)		1000 (30.3)	

College or higher	6814 (65.9)	6084 (58.9)	573 (8.4)	261 (4.3)	2777 (40.8)	2661 (43.7)	1769 (26.0)	1565 (25.7)
<b>Children under 18 yrs. old in one's family</b>			0.008	0.000	0.000	0.000	<b>0.930</b>	<b>0.473</b>
No	6893 (66.7)	7125 (68.9)	<b>848</b> <b>(12.3)</b>	<b>632</b> <b>(8.9)</b>	2534 (36.8)	2896 (40.6)	2033 (29.5)	2030 (28.5)
Yes	3441 (33.3)	2823 (27.3)	388 (11.3)	147 (5.2)	<b>1535</b> <b>(44.6)</b>	<b>1311</b> <b>(46.4)</b>	1012 (29.4)	784 (27.8)
<b>occupational classification</b>			0.000	0.000	0.000	0.000	0.000	0.000
White collar	5253 (50.8)	5788 (56.0)	294 (5.6)	158 (2.7)	2190 (41.7)	2451 (42.3)	1392 (26.5)	1522 (26.3)
Pink collar	1253 (12.1)	2572 (24.9)	<b>313</b> <b>(25.0)</b>	<b>482</b> <b>(18.7)</b>	507 (40.5)	1158 (45.0)	339 (27.1)	732 (28.5)
Blue collar	3828 (37.0)	1588 (15.4)	629 (16.4)	139 (8.8)	1372 (35.8)	598 (37.7)	1314 (34.3)	560 (35.3)
<b>Employment type</b>			0.000	0.000	0.009	0.078	0.000	0.000
Permanent employees	9269 (89.7)	8972 (86.8)	1032 (11.1)	631 (7.0)	3671 (39.6)	<b>3826</b> <b>(42.6)</b>	2638 (28.5)	2445 (27.3)
Temporary employees	650 (6.3)	839 (8.1)	<b>146</b> <b>(22.5)</b>	116 (13.8)	228 (35.1)	331 (39.5)	236 (36.3)	301 (35.9)
Day employees	415 (4.0)	137 (1.3)	58 (14.0)	<b>32</b> <b>(23.4)</b>	<b>170</b> <b>(41.0)</b>	50 (36.5)	<b>171</b> <b>(41.2)</b>	<b>68</b> <b>(49.6)</b>
<b>Monthly income (1,000KRW)</b>			0.000	0.000	0.000	0.000	0.000	0.000
<2,000	756 (7.3)	2574 (24.9)	88 (11.6)	198 (7.7)	224 (29.6)	985 (38.3)	299 (39.6)	906 (35.2)
2,000-3,000	3272 (31.7)	4946 (47.9)	501 (15.3)	458 (9.3)	1209 (36.9)	2028 (41.0)	1081 (33.0)	1326 (26.8)

3,000-4,000	3399 (32.9)	1689 (16.3)	409 (12.0)	83 (4.9)	1412 (41.5)	809 (47.9)	934 (27.5)	398 (23.6)
≥4,000	2907 (28.1)	739 (7.2)	238 (8.2)	40 (5.4)	1224 (42.1)	385 (52.1)	731 (25.1)	184 (24.9)
<b>Company size (the number of employees)</b>	0.000		0.000		0.088		0.013	
							0.000	
							<b>0.296</b>	
1-49	6715 (65.0)	7602 (73.6)	960 (14.3)	686 (9.0)	<b>2691</b> <b>(40.1)</b>	3154 (41.5)	2074 (30.9)	2176 (28.6)
50-299	2225 (21.5)	1792 (17.3)	177 (8.0)	69 (3.9)	861 (38.7)	800 (44.6)	605 (27.2)	480 (26.8)
300-	1394 (13.5)	554 (5.4)	99 (7.1)	24 (4.3)	517 (37.1)	<b>253</b> <b>(45.7)</b>	366 (26.3)	158 (28.5)

<sup>a</sup>P–value of the Chi–square test comparing the prevalence of long workign hours across key covariates

<sup>b</sup>P–value of the Chi–square test comparing the prevalence of work–family conflict across key covariates

<sup>c</sup>P–value of the Chi–square test comparing the prevalence of depressvie symptoms across key covariates

Table 3. Mediation effect of work–family conflict in the relationship between long working hours and depressive symptoms in Study population: Baron & Kenny method and Sobel test

		Male				Female			
Steps	Variables	PR	(95% CI)	SE	p-value	PR	(95% CI)	SE	p-value
1	Long working hours → Work-family conflict	1.45	(1.37, 1.55)	0.05	0.000	1.22	(1.13, 1.32)	0.05	0.000
2	Long working hours → Depressive symptoms	1.31	(1.21, 1.42)	0.05	0.000	1.34	(1.21, 1.48)	0.07	0.000
3	Long working hours → Depressive symptoms	1.24	(1.15, 1.35)	0.05	0.000	1.30	(1.17, 1.43)	0.07	0.000
	Work-family conflict → Depressive symptoms	1.38	(1.30, 1.47)	0.04	0.000	1.35	(1.27, 1.43)	0.04	0.000
Sobel test		Z=22.91, p<0.05				Z=19.65, p<0.05			

\* Adjusted for age, education level, children in family, employment type, occupational classification, monthly income, and company size

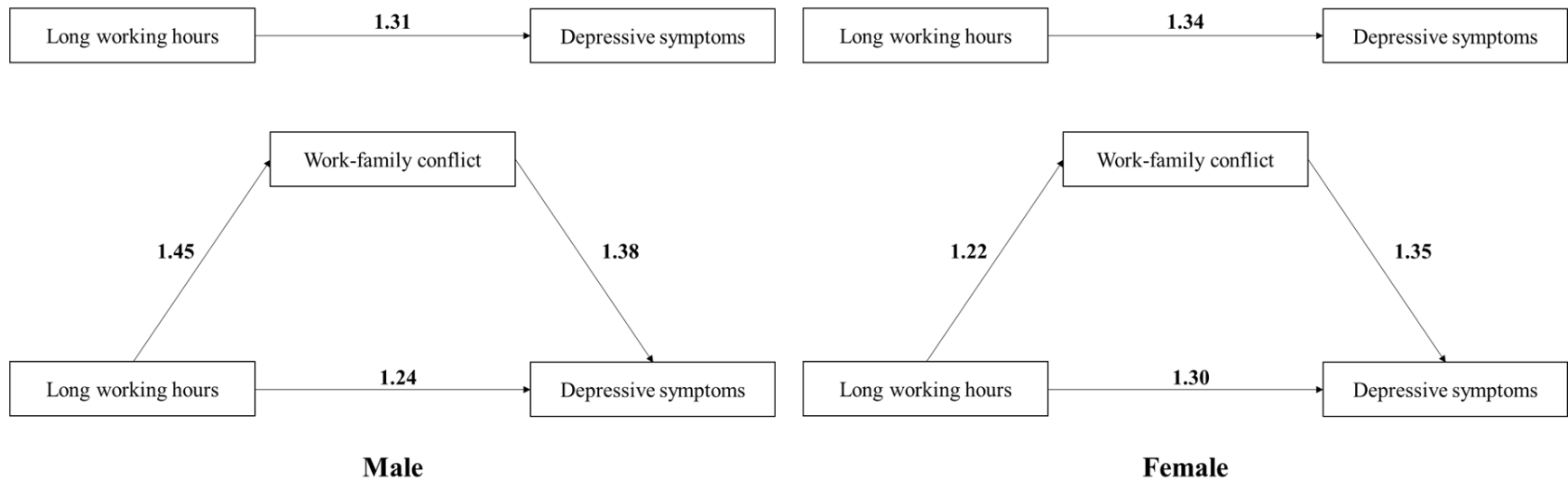


Figure 3. Mediation effect model of work–family conflict in the relationship between long working hours and depressive symptoms.

Table 4. Decomposition of effect of work–family conflict and long working hours on workers' depressive symptoms in study population: Mediation analysis by bootstrapping

	<b>Male</b>		<b>Female</b>	
	Estimate	Bootstrapping BC 95% CI	Estimate	Bootstrapping BC 95% CI
<b>Indirect</b>	1.06	(1.04, 1.07)	1.03	(1.01, 1.04)
<b>Direct</b>	1.24	(1.15, 1.34)	1.30	(1.18, 1.44)
<b>Total</b>	1.31	(1.21, 1.42)	1.33	(1.22, 1.49)

BC, bias corrected; 1000 bootstrap samples

\* Adjusted for age, education level, children in family, employment type, occupational classification, monthly income, and company size

Table 5. Stratification by work–family conflict to determine effect modification between work–family conflict and long working hours and the risk of depressive symptoms

Long working hours	Male					Female				
	n	(%)	PR	(95% CI)	p-value	n	(%)	PR	(95% CI)	p-value
<b>All subject</b>										
No	2568	(28.2)	1.00	(Reference)		2521	(27.5)	1.00	(Reference)	
Yes	477	(38.6)	1.31	(1.21, 1.42)	0.000	293	(37.6)	1.34	(1.21, 1.48)	0.000
<b>Work-family conflict No</b>										
No	1413	(24.9)	1.00	(Reference)		1301	(24.3)	1.00	(Reference)	
Yes	194	(32.9)	1.24	(1.10, 1.41)	0.001	130	(33.5)	1.26	(1.08, 1.47)	0.003
<b>Work-family conflict Yes</b>										
No	1155	(33.8)	1.00	(Reference)		1220	(32.0)	1.00	(Reference)	
Yes	283	(43.7)	1.23	(1.11, 1.37)	0.000	163	(41.7)	1.33	(1.16, 1.51)	0.000

\* Adjusted for age, education level, children in family, employment type, occupational classification, monthly income, and company size

Table 6. Interaction effect of long working hours and work–family conflict on depressive symptoms

long working hours	work-family conflict	male		female	
		PR (95% CI)	p-value	PR (95% CI)	p-value
No	No	1.00 (Reference)		1.00 (Reference)	
No	Yes	1.39 (1.30,1.48)	0.000	1.36 (1.27,1.45)	0.000
Yes	No	1.26 (1.11,1.43)	0.000	1.36 (1.17,1.58)	0.001
Yes	Yes	1.70 (1.54,1.89)	0.000	1.70 (1.49,1.93)	0.000

\* Adjusted for age, education level, children in family, employment type, occupational classification, monthly income, and company size



## 4. Discussion

The purpose of this study was to determine the role of work–family conflict in the relationship between long working hours and work–family conflict.

Work–family conflict had a statistically significant mediation effect on the pathway linking long working hours to depressive symptoms. (Table 3–4) This finding supports previous empirical studies investigating a positive relationship between working hours and work–family conflict [81, 91].

According to the insufficient recovery mechanism of long working hours to health, long working hours lead to increased time and energy resources in the work domain [35]. As a result, devoting time and energy to work instead of home obligations and responsibilities in the family domain can cause work–family conflict. Finally, it can have a negative impact on mental health [92].

In addition, I discovered a statistically significant interaction between work–family conflict and long working hours on depressive symptoms. (Table 5–6) It means that the prevalence of depressive symptoms may differ among workers with the same working hours, depending on the level of work–family conflict.

This finding might be because how efficiently individuals use resources determines the work–family conflict that affects workers' mental health. Even if they work the same hours, they may experience more stress than workers with someone to help them [39–41]. Adkins and Premeaux [39] found that managerial support, a work–family culture component in that a manager supports employees' needs to maintain a healthy work–life balance, mitigated the connection between working hours and work–family conflict.

Work–family conflict had mediation and effect modification in the relationship between long working hours and depressive symptoms in both genders. This result only partially supports the results of previous research. Both men and women are more likely

to have health problems if they have work–family spillover [31]. Moreover, work–family conflict was one of the risk factors for depression for both males and females [29]. The Seoul National University Center for Transnational Migration and Social Inclusion (CTMS) surveyed 2,016 married men and women with children to identify issues related to COVID–19 and childcare. According to this research, 70.7% of fathers and 84.2% of mothers who work have more difficulty balancing work and childcare during the social distancing period (December 2020–February 2021) than before [94]. It means that work–family conflict and its impact on individual mental health are not just women’s problems.

However, this result should be interpreted carefully because the meaning of work–family conflict might differ for genders [93]. It is undoubtedly true that the prevalence of participating in housework and childcare is mainly different between males and females [43]. However, for cultural and social reasons, males may be prepared to adapt to stressful conditions in the work environment. In contrast, females may have been socialized to cope effectively with stressors in the family domain [93, 94]. For this reason, there may be a similar association between work–family conflict and mental health between genders, despite the substantial difference in housework engagement between males and females [95].

This study has a few limitations. First, I did not simultaneously observe the mediation effect and the effect modification. Because of the cross–sectional dataset, the overlap of the two effects could not be explained. Longitudinal research that can identify mediation and effect modifiers together, such as moderated–mediation, should be conducted in the future to explain this adequately [96, 97].

Second, 52 hours was set as the cut–off for the long working hour following the Korean Labor Standard Act in this study [83]. However, long working hours are defined as an average of 48 hours per week by the working hour guidelines from the International Labor Organization (ILO) and the European Union (EU) [98]. Since

Korean and international standards for working hours are different, it is necessary to find out the health effects of the difference in working hours in the future.

Third, work–family conflict has a shared definition, but no standardized measurement exists. The work–family conflict items used in this study are the same as those of European Working Conditions Surveys (EWCS). And work–family conflict variable was coded as binary variables using the median value since there was no clear criterion. EWCS investigates the working environment of 35 European countries, in which work–family items have been used to assess their association with health outcomes in several studies [99–102]. For example, work–family conflict was reported to have a strong association with self–reported general health in Europe [100]. However, when reviewing the measurement of work–family conflict used in previous research, there was no standard measure of work–family conflict. Even though the same tool was used, the classification criteria were different. (Supplementary Table 4) Since work–family conflict has been identified as a major risk factor for workers’ mental health, it is necessary to investigate the established definition of it and to develop a standardized tool.

Lastly, unmeasured potential confounders might exist. In this study, one family environment variable, children under 18 years old in the family, was included as a covariate. Work–family conflict is a variable that integrates various factors in both work and family domains [35, 42]. Because work–family conflict is complicated to explain, there might be essential factors confounding the association that the research was trying to identify, such as the presence of another child caregiver.

Despite the limitations, this study has a few strengths. First, this study analyzed the national representative data on workers in South Korea. Second, to our knowledge, this study was considering the work–family conflict effect on the relationship between long working hours and workers' mental health.

In sum, our results suggest that work–family conflict has a mediator and moderator effect on the relationship between long working hours and work–family conflict. Therefore, to improve workers' mental health, both long working hours and work–family conflict should be considered.

## 5. Conclusion

This study investigated the role of work–family conflict in the relationship between long working hours and work–family conflict after stratified by gender.

We found that work–family conflict has mediation and effect modification in the association between long working hours and work–family conflict in both genders.

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## Supplementary Materials

("long working hour"[TIAB] OR "long working hours"[TIAB] OR "long work hours"[TIAB] OR "long hours"[TIAB] OR "extended working hours"[TIAB] OR "extended hours"[TIAB] OR "extended work"[TIAB] OR "workhours"[TIAB] OR "work hours"[TIAB] OR "overtime"[TIAB] OR "overwork"[TIAB]) AND ("mental disorders"[mh] OR "psychological health"[TIAB] OR "psychological dis\*"[TIAB] OR "psychiatric"[TIAB] OR "distress"[TIAB] OR "mood dis\*"[TIAB] OR "depress\*"[TIAB] OR "anxiety"[TIAB] OR "panic"[TIAB] OR "emotions"[mh] OR "phobi\*"[TIAB] OR "obsessive-compulsive"[TIAB] OR "OCD"[TIAB] OR "GAD"[TIAB] OR "emotional\*"[TIAB] OR "well-being"[TIAB] OR "behavioral symptoms"[TIAB] OR "affective symptoms"[TIAB] OR "sleep disorders"[TIAB] OR "post-traumatic stress"[TIAB] OR "PTSD"[TIAB] OR "depressive disorder" [mh] OR "depressive" [TIAB] OR "depressive disorder" [TIAB] OR "depression" [TIAB] OR "depression"[mh])

**Supplementary Figure 1. Searching keywords: long working hours.**

Supplementary Table 1. Review of 12 studies on the association between long working hours and mental health except for depressive symptoms

No	Author	Year	Study design	Study population	N	Exposure variable	Outcome variable	Main findings	Covariates
1	Kim, B.H. and H.E. Lee	2015	Cross-sectional study	the 3rd Korean Working Condition Survey in 2011	20544	weekly working hours (<40, 40-48, 49-60, and 60<) occupation (manual and non-manual)	sleep disturbance ("During the past 12 months, have you experienced sleep disturbance or insomnia?")	Long working hours can be a risk factor for sleep disturbance in Korean workers. The association was especially prominent in male non-manual workers.	age, educational level, marital status, salary, shift work, smoking, alcohol consumption and self-rated health
2	Yoon, J.H., et al.	2015	Cross-sectional study	the Korea National Health and Nutrition Examination Survey 4-5th of economically active workers aged less 60yrs	12076	weekly working hours (<52, 52-59, and 60<=)	suicidal thoughts "Have you ever been willing to die during the past year?"	long working hours were linked to suicidal thoughts for both genders. And the odds of those suicidal thoughts were higher for lower socioeconomic groups.	occupation (white, pink, blue) work schedule (regular, shift work) household income, marital status, underline disease
3	Lee, H.E., et al.	2017	Cross-sectional study	the 5th Korean Working Condition Survey in 2017	28345	weekly working hours (31-40, 41-52, and >52) variability in daily or weekly working hours (same number and different number)	self-reported depressive symptoms and anxiety ("Over the last 12 months, did you have depressive symptoms?" and "Over the last 12 months, did you have anxiety?")	Variable daily or weekly working hours were associated with poorer self-reported depressive and anxiety symptoms in Korea, among full-time and non-shift workers.	age, sex, education, industry, salary, and workers' choice of the working hour

4	Lee, K., et al.,	2017	Cross-sectional study	white-collar workers	1122	weekly working hours (40-44, 45-49, 50-54, 55-59, and 60-)	Psychosocial stress responses (Psychosocial Well-being Index - Short Form, PWI-SF)	long working hours are significantly related to psychosocial stress responses among white-collar workers in one Korean company	gender, age, marital status, educational level, position, psychosocial working conditions
5	Lee, H.E., et al.	2020	longitudinal study	the matched data with Korean National Health and Nutrition Examination Survey (KNHANES) between 2007-2015 and death registry data compiled by the Korea National Statistical Office (KNOS) from 2007-2016	14484	weekly working hours: 15-34, 35-44, 45-52, and <52	Deaths from total external cause, subsets including accidents, and intentional self-harm	Long working hours are associated with higher suicide mortality rates in Korea. No statistically significant associations were found for accident mortality.	age, sex, household income, education, occupation, and depressive symptoms
6	Park, S., et al.	2020	Cross-sectional study	the Youth Panel 2007 of young adult employees (aged 20 to 35)	3332	weekly working hours: 31-40, 41-50, 51-60, and >60	stress ("How often do you feel stressed in your daily life?") depression ("Have you ever felt sadness or feeling of despair that interfered with your daily life for two consecutive weeks over the past year?") suicidal thoughts ("Have you ever thought about wanting to die in the last year?")	Long working hours were associated with stress, depression, and suicidal ideation	sex, age, marriage status, region, and educational level

7	Choi, H., et al.	2020	Cross-sectional study	the 5th Korean Working Conditions Survey of non-shift daytime wage workers	26522	weekly working hours: $\leq 40$ , 41-52, and $>52$	sleep disorder ("difficulty in falling asleep", "frequent waking", and "waking up with fatigue"	Working for extended hours was associated with increased fatigue upon waking. Long work hours showed no significant relationship with difficulty in falling asleep or with frequent waking.	personal characteristics (sex, age, education level, monthly income, subjective health condition, disease or health problems, depression, and anxiety  occupational factors (duration of the service, size of the workplace, type of occupation, and commuting time)
8	Lee, D.W., et al.	2021	longitudinal study	the Korea Health Panel Study (KHPS) data from 2011 to 2014	25023	weekly working hours: $<40$ , 40, 41-52, $>52$	lifestyle behaviors (smoking status, alcohol consumption status, and regular exercise status	Long working hours are associated with unhealthy lifestyles, such as cigarette smoking, alcohol consumption, physical inactivity, and insufficient sleep.	gender, age, education level, and household income

9	Lee, S., J.Y. Choi, and W. Lee	2021	Cross-sectional study	the Korean Longitudinal Study on Aging during the period 2006–2018	2518	weekly working hours: <60, >60	cognitive decline (Korean version of the Mini-Mental State Examination (K-MMSE))	The study furthers understanding of the effects of long working hours on cognitive decline among female workers. Further research is required to determine the effects of long working hours on cognitive functions.	age, sex, education level, and marital status
10	Park, J. and Y. Kim	2021	Cross-sectional study	the 5th Korean Working Conditions Survey (2017) of wage employees and self-employed	waged employees 30,108 self-employed 14,459	weekly working hours: <40, 40-47, 48-59, and >60	psychological well-being (WHO-5)	The symptoms of depression and anxiety were significantly higher in the group weekly working more than 52 hours than in the group working fewer than 40 hours. Employment status (employee vs. self-employed) moderated the relationship between weekly working hours and psychological well-being.	demographic (sex, age) socioeconomic (education, monthly income, occupational class)



11	Kim, S.Y., S.I. Kim, and W.J. Lim	2021	Cross-sectional study	the Korean National Health and Nutrition Examination Survey (KNHANES) of shift workers	13628	weekly working hours ( $\leq 40$ , 40.1-52, and $> 52$ )	suicidal ideation ("Over the last year, have you ever felt that you would be better off dead?")  sleep duration ( $< 6$ , 6-7, 7-9, 9-10, $\geq 10$ )	Shorter or longer sleep durations, and long working hours were associated with a higher risk of suicidal ideation. Under long working hours, male shift workers or those aged $< 45$ years were more vulnerable to suicidal ideation.	age, sex, marital status, education level, income, alcohol consumption, smoking status, anxiety/depressive symptoms, BMI
12	Park, M.Y., et al.	2022	Cross-sectional study	the Korea National Health and Nutrition Examination Survey VI and VII of paid workers aged over 19yrs	9294	weekly working hours (35-51 and $\geq 52$ )  Equivalized household income (low, low-medium, medium-high, and high)	Self-rated health ("very good", "good", "fair", "poor", and "very poor")	Long working hours increased the risk of poor self-rated health in the group with the highest income, but not in the group with the lowest income. The overall weighted prevalence of poor self-rated health was higher in the low-income group.	marital status, education level, employment status, occupations, smoking status, problematic drinking, disease status

Supplementary Table 2. Review of 8 studies on the association between long working hours and depressive symptoms

No.	Author	Year	Study design	Study population	N	Exposure variable	Outcome variable	Main findings	Covariates
13	Lee, K.H., et al.	2013	Cross-sectional study	the 2nd Korean Working Condition Survey	993	weekly working hours: 35-47, 48-52, 53-60, and <60	Depressive symptoms (WHO-5)	In comparing the low-mood group and possible depression group, as work hours increased the odds ratio gradually significantly increased.	demographic, health behavior, socioeconomic (gender, age, level of education, smoking, alcohol consumption, obesity, physical activity, income, company size, work schedule)
14	Kim, W., et al.	2016	longitudinal study	Korean Welfare Panel Study (KOWEPS), 2010-2013	2733	weekly working hours: 35-40, 41-52, and 53-68, <68 employment type (permanent, precarious)	Depressive symptom (CES-D)	Employees in precarious employment who worked above 68 hours/week exhibited the highest odds of depressive symptoms compared with permanent employees working 35 to 40 hours/week.	demographic (age, gender) socioeconomic (education level, equalized household income, marital status, job satisfaction) health related covariates (chronic disease status)

15	Yoon, Y., et al.	2018	Cross-sectional study	the Korea Working Conditions Survey in 2014 of employees aged 15hrs of above and working more than 35hrs per week	23197	Working hours (35–39, 40, 41–52, 53–68, and > 68 hrs./week)	Depressive symptoms (WHO-5)	<p>The risks of depressive symptoms were significantly higher in people who worked 35–39 hrs./week, 53–68 hrs./week, and more than 68 hrs./week than 40 hrs./week.</p> <p>Social support and inadequate reward were important factors in the long working hours affecting depressive symptoms</p>	<p>Socio-psychological work environment</p> <p>Social support</p> <p>socioeconomic position (education level, monthly individual incomes, job category, employment state)</p> <p>physical problems</p>
16	Choi, E., et al.	2021	Cross-sectional study	the Korea National Health and Nutrition Examination Surveys (KNHANES) conducted in 2014, 2016, and 2018 of workers aged 19 years or above	7082	Working hours (35–39, 40, 41–52, 53–68, and ≥69 hrs./week)	Depressive symptoms (PHQ-9)	<p>working ≥69 hrs./week were more likely to have moderate to severe depressive symptoms compared to those working 40 hrs./week.</p> <p>The association between longer working hours and depressive symptoms was especially prominent in female workers, standard wage workers, and workers with low-income levels.</p>	<p>sociodemographic (age, gender, education level, monthly household income, marital status, residential region, job status, job type, presence of shift work)</p> <p>health-related (number of chronic diseases, alcohol consumptions, cigarette smoking, BMI, physical activity)</p>

17	Kim, J. and E.C. Park	2021	Cross-sectional study	first wave to fourth wave of the Korea Longitudinal Study of Aging of Korean aged 45 years or above	9845	Working hours(unemployed(0hr), <40, 41-68, and ≥69 hrs./week	Depressive symptoms (CES-D10	An increase in depressive symptoms was associated with unemployed males and females working ≥69 h compared to those working 41–68h.	socio-demographic (age, marital status, education level, household income, wealth)  health-related (smoking, alcohol consumption, the number of chronic diseases, instrumental activities of daily living (IADL) disability, cognitive function)
18	Han, S., et al.	2021	Cross-sectional study	the Korea National Health and Nutrition Examination Surveys VI and VII (2013–2018) of	14625	weekly working hours: 30–40, 41–50, 51–60, and >60 hrs./week	Depressive mood ("Have you felt sadness or despair which hindered everyday life consistently for 2 weeks or more during the last year?" Suicidal ideation ("Have you ever seriously considered suicide in the last year?")	Long working hours are significantly associated with depressive mood and suicidal ideation.	demographic (BMI, marital status) socioeconomic (education level, occupation type, shift work status) medical histories (perceived health status, major comorbidity) lifestyle habits (smoke, alcohol consumption, sleep duration, aerobic physical activity)
19	Lee, Y. and H. Park	2022	Cross-sectional study	cohort of aged more than 18yrs of age receiving regular medical examinations at two hospital health centers	269192	weekly working hours: <40, 41-52, and >52 hrs./week  work type (shift worker and day workers)	Depressive symptom (Center for Epidemiological Studies-Depression scale, CES-D) Anxiety (Beck Anxiety Inventory, BAI)	Significant association between long working hours and depression and anxiety symptoms, regardless of gender and shift work schedule.	sex, age, BMI, education, marital status, smoking, alcohol, and history of depression or anxiety disorder

20	Park, M.Y., et al	2022	Cross-sectional study	the Korea National Health and Nutrition Examination Survey (KNHANES)	7775	weekly working hours: 30-52 and >52	depressive symptoms (PHQ-9)	Long working hours associated with high risk for depression in the group with the highest income, but not in the group with the lowest income	household income, marital status, cohabiting subjects, education level, occupation, types of work Schedule
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("work–family conflict"[TIAB] OR "work family conflict"[TIAB] OR  
 "WFC"[TIAB] OR "family–work conflict"[TIAB] OR "family work  
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 "PTSD"[TIAB] OR "depressive disorder" [MeSH Terms] OR  
 "depressive" [TIAB] OR "depressive disorder" [TIAB] OR  
 "depression" [TIAB] OR "depression" [MeSH Terms])

**Supplementary Figure 2. Searching keywords: work–family conflict.**

Supplementary Table 3. Review of 17 studies about the association between work–family conflict and long working hours on workers mental health

No	Author	Year	Study design	Study population	N	Exposure variable	Outcome variable	Main findings	Covariates
1	Väänänen, A., et al.	2004	Cross-sectional study	Finnish 10 Town Study in 1997 of full-time employees	6442	Paid work hours, Domestic work hours Total work hours Domestic responsibilities Negative work-family spillover	Psychological distress (Goldberg's General Health Questionnaire, GHQ-12) Suboptimal health Sickness absence	Negative work-family spillover especially is associated with health problems among both women and men, and negative family-work spillover is related to a poorer health status among women. Long domestic work hours were associated higher rate of sickness absence among the men, but there was no such increase among the women.	age, family characteristics (marital status, dependent children, monthly income)
2	Sekine, M., et al.	2006	Cross-sectional study	The Japanese Civil Servants Study	3556	work characteristics (grade of employment, job-demand-control-support model, work hours, and shift work) family characteristics (domestic role, family-work conflicts)	sleep quality (Pittsburgh Sleep Quality Index)	Shorter and longer working hours, shift work, higher family-to-work conflict, and higher work-to-family conflict were independently associated with poorer sleep quality in both men and women.  Women tended to have poorer sleep quality than men. The sex difference was attenuated and no longer significant when adjustments were made for work and family characteristics.	age, gender, longstanding illness

3	Matthews, R.A., C.A. Swody, and J.L. Barnes-Farrell	2012	Cross-sectional study	workers at least 18 years of age, employed at their current organization for at least 3 months and work at least 40 h a week	522	Role salience: work, family (Occupational Role Value Scale) Behavioral Involvement: work and family Work hours Work-family conflict: work-to-family and family-to-work End-of-workday strain	Life satisfaction	both family-to-work conflict and end-of-workday strain were negatively related to life satisfaction. behavioral family involvement: work hours (-), family-to-work conflict (-) behavioral work involvement: work hours (-)	gender, age, children, organizational tenure, education level,
4	Wang, J.L., et al.	2012	Cross-sectional study	population-based longitudinal study of the working population of workers who had MDD diagnosis	834	Workplace psychosocial factor (Job content questionnaire, ERI) Work-family conflict	Depressive symptoms (PHQ-9)	Long working hours, negative thinking and having co-morbid social phobia were predictive of persistence of MDD. Perceived work-family conflict, the severity of a major depressive episode and symptoms of depressed mood were significantly associated with the recurrence of MDD.	sex, age, marital status, educational level, personal annual income, average weekly working hours, job type and job gradient



5	Fujimura, Y., M. Sekine, and T. Tatsuse	2014	Cross-sectional study	Japanese Civil Servants Study (JACS study) of civil servants aged 20-59 working local government on the west coast of Japan	3594	work characteristics (occupational grade, working hours), family characteristics (marital status, living with family) and lifestyle (BMI, smoking status)	work-family conflict	Working long hours was the primary determinant of work-to-family conflict in both sexes and that being married and raising children were strong factors of family-to-work conflict in women only.	age, gender
6	Cooklin, A.R., et al.	2015	longitudinal study	the Longitudinal Study of Australian Children of fathers of infants (aged 6-12 months)	3243	Employment characteristics (work hours, night shift, works weekends, leave entitlements, parental leave entitlements, job security, job autonomy, flexible working hours)	Psychological distress (Kessler-6) Work-family conflict Work family enrichment	Long and inflexible work hours, night shift, job insecurity, a lack of autonomy and more children in the household were associated with increased work-family conflict, and this was in turn associated with increased distress.	age, education, income, maternal employment, maternal mental health, and relationship quality
7	Cooklin, A.R., et al.	2016	longitudinal study	working mothers and working fathers: kindergarten cohort of Australian Children (LSAC)	6153(working mothers: 2693 and working fathers: 3460)	work-related factors: weekly work hours, occupational status, job quality) child factors (the number of children, infant, child w/ special help)	work-family conflict work-family conflict transitions	Mental health is directly influenced by the WFC interface Predictors of conscript and chronic WFC - man: Poor job quality, a skilled occupation and having more children - woman: skilled occupation, work hours, job insecurity	age, education, household income, parents' health problem, prior mental health

8	Wang, X.L., P.S. Yip, and C.L. Chan	2016	Cross-sectional study	local relief workers in the worst quake-hit regions in China in 2008	70	bereavement, depression and posttraumatic stress, daily work hours, job burnout, work-family conflict, and work engagement	post disaster suicidal ideation	Approximately 21.4% of participants reported suicidal ideation after the earthquake in comparison with 7.1% before the earthquake. One potential risk factor was an interaction effect of job burnout and work-family conflict. Potential protective factors included daily work hours and work engagement.	sex, married, college
9	Lopez-Ruiz, M., et al.	2017	Cross-sectional study	The First Central American Survey of Working Conditions and Health (2011) of non-agricultural workers (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama)	8680	weekly paid working hours marital status number of children aged under 15 whether care for people with functional diversity or ill  *functional diversity: new paradigm trying to overcome the negative connotations of the disability term and its implication	Self-perceived health Mental health status (General Health Questionnaire, 12-item version)	A clear pattern of association was observed for women in informal employment who were previously married, had care responsibilities, long working hours, or part-time work for both self-perceived and mental health.	employment status, type of contract, county, age, occupation  stratified by sex and social security coverage

10	Xu, X., et al.	2019	Cross-sectional study	US dual-earner families	365	partner's housework hours work-family conflict partner's marital	Satisfaction partner's depression	One's work time demands spilled over to the family domain and crossed over to his or her spouse : the effects of work hours were identical between men and women husbands' housework hours -> wives' marital satisfaction (-) wives' depression (+) wives' housework hours -> husbands' marital satisfaction (-) depression (-)	the number of children, socio-economic status (education and income), the number of jobs, employment status, and the gender role expectations
11	Namazi, S., et al.	2019	Cross-sectional study	US correctional supervisors	157	shift work, overtime work, childcare, adult care (m)work-to-family conflict and family-to-work conflict	depressive symptoms (Brief Symptom Inventory, BSI)	Working overtime had an indirect effect on correctional supervisors' depressive symptoms, mediated by work-to-family conflict.	sex, age, marital status, educational attainment level, family income level, job classification, job tenure

12	Niedhammer, I., et al.	2020	Cross-sectional study	French national working population	25977	various types of occupation exposures 1) job strain model and reward factor 2) psychosocial work factors: workplace violence, work-family conflict and ethical conflict, temporary work, emerging factor (teleworking, lean, meaning of work) 3) working time: long working hours, shift work, night work 4) other: physical, biomechanical, chemical, biological exposures	depressive symptoms (PHQ-9)	Work-family conflicts for both genders, and long working hours among women were risk factors for depression. There were some differences in these associations between genders between psychosocial work exposures and depression	gender, age, marital status, occupation, and economic activity
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13	Young, M., S. Montazer, and D. Singh	2020	Cross-sectional study	Toronto Study on Neighborhood Effects on Health and Well-Being (NEHW)	236(132 fathers, 164 mothers)	Respondents' work hours childcare availability total childcare spaces	Psychological distress work-to-family conflict	Mothers experience greater conflict than fathers when in high-resourced areas. Fathers who work long hours and reside in a desert report greater psychological distress than fathers in non deserts. (desert: childcare desert) => contrary patterns to the observed results for mothers' distress by childcare availability	gender, marital status, partners' work hours, household income, Canadian born
14	Boini, S., et al.	2020	longitudinal study	general French population aged 20-74 from national survey ("Santé et Itinéraire Professionnel" or "Health and Career Paths", SIP)	5132	The short-term, lagged, and cumulative effects of psychosocial factors (PSF) - Labour intensity and working time (including long working hours, Work-family life imbalance) - Emotional demand - Autonomy - Social relationships at work - Conflict of values - Job insecurity	mental health: Major depressive disorder (MDD), generalized anxiety disorder (GAD)	men: short-term and cumulative-and to a lesser extent lagged-associations of four labour-intensity factors with MDD/GAD occurrence (high volume of work, pressure at work, high complexity, and long working hours). women: the short-term and cumulative associations of five PSF (mostly emotional demand factors, lack of reward and work-family imbalance)	Occupational: work psychosocial strain, past and current occupational physical exposure, periods of career paths, employment status, type of contract, activity sector, part-time employment gender, age, level of education, mental health history, chronic health problems, past traumatic events

15	Frank, E., et al.	2021	longitudinal study	US physicians enrolled in the Intern Health Study	276	Work and Family Conflict Scale	depressive symptoms (PHQ-9) anxiety (Generalized Anxiety Disorder, GAD-7)	Significant gender disparities in work and family experiences and mental health symptoms among physician parents during the COVID-19 pandemic,	age, relationship status, the number of children, pre-COVID 19 employment, partner's current employment, partner's profession, specialty
16	Yu, J. and S. Leka	2022	Cross-sectional study	full-time employees from 25 IT companies in China	265	Worktime Control (WTC) Voluntary and Involuntary Overtime	mental health (Depression Anxiety and Stress Scales, DASS-22) Work-family Conflict (WFC)	Control over daily hours was related to decreased stress and work-family conflict Generally, control over time-off was beneficial to females and employees with dependents.	gender, age, marital status, dependents' situation, education level and income level
17	Honda, A., et al	2022	Cross-sectional study	three types of long-term care workers: home-based, community-based, and institutional	944	type of occupation, occupational position, work hours, job satisfaction, annual income	Effort-reward imbalance	Low job satisfaction, being a care manager, holding a position of department head, working long hours, and having family-related stress were the common factors associated with ERI in employees across all three types of long-term care setting.	age, sex, family-related stress, employment status

Supplementary Table 4. Review of work–family conflict measurements in 15 studies

WFC Q	item	point scale	cut-off	Author	Year	Study design	N
1) How often do you feel that work roles and family roles conflict?	1	5	-	Xu, X., et al.	2019	Cross-sectional	365
1) How often do the demands of your JOB interfere with your family life?	1	?	-	Niedhammer, I., et al.	2020	Cross-sectional	25977
Labour intensity and working time: Work–family life imbalance-- Difficulties reconciling work and family life	1	4	-	Boini, S., et al.	2020	longitudinal	5132
experienced stress: providing care for family members, intra-family personal conflict, housework	1	2	-	Honda, A., et al.	2022	Cross-sectional	944
1) How often do things going on AT WORK make you feel tense and irritable at HOME? 2) How often do the demands of your JOB interfere with your family life?	2	5	mean rating, summed and divided by 5	Namazi, S., et al.	2019	Cross-sectional	157
Negative work-family spillover "My paid work is so burdensome that it makes it difficult for me to perform household duties." 1) childcare, 2) household duties and 3) other obligations,	3	5	divided into four group according to the mean score	Väänänen, A., et al.	2004	Cross-sectional	6442

1) I came home from work too tired to do some of the things I wanted to do				Matthews, R.A., C.A. Swody, and J.L. Barnes-Farrell			
2) Because of my job, I didn't have the energy to do things with my family or other important people in my life	3	4	average		2012	Cross-sectional	522
3) My job made it difficult to maintain the kind of relationships with my family that I would like							
1) The time I must devote to my job keeps me from participating equally in household responsibilities and activities							
2) I am often so emotionally drained when I get home from work that it prevents me from contributing to my family	3	5		Yu, J. and S. Leka	2022	Cross-sectional	265
3) Behaviour that is effective and necessary for me at work would be counterproductive at home							
	4	3	sum of score (4-12) high score -> high conflict	Sekine, M., et al.	2006	Cross-sectional	3556
1) Your job reduce the amount of time you can spend with the family							
2) Problems at work make you irritable at home	4	3	sum of score (4-12) dichotomized by median value	Wang, J.L., et al.	2012	Cross-sectional	834
3) Your work involves a lot of travel away from home							
4) Your job takes so much energy you don't feel up to doing things that need attention at home	4	3	sum of score (4-12) first tertile group: high	Fujimura, Y., M. Sekine, and T. Tatsuse	2014	Cross-sectional	3594
Strains between work and family							
W->F "Because of my work responsibilities	4	5	continuous scale high scores -> greater conflict	Cooklin, A.R., et al.	2015	longitudinal	3243
1) I have missed out on home or family activities that I would like to take part in							
2) My family time is less enjoyable and more pressured	4	5	average score as cut-off (>3)	Cooklin, A.R., et al.	2016	longitudinal	6153
W->F "Because of my family responsibilities:							
3) My work time is less enjoyable and more pressured							



4) I have to turn down work activities or opportunities that I would prefer to take on								
1) How often have you not had enough time for your family or other important people in your life because of you job	4	5	higher score -> greater conflict	Young, M., S. Montazer, and D. Singh	2020	Cross-sectional	236	
2) How often have you not had the energy to do things with your family or other important people in your life because of your job								
3) How often has your job kept you from doing as good a job at home as you could?								
4) How often has your job kept you from concentrating on important things in your family and personal life								
1) My work me spending sufficient quality time with my family	5	7	score range: 5-35	Frank, E., et al.	2021	longitudinal	276	
2) There is no time left at the end of the day to do the things I'd like at home (e.g., chores and leisure activities)								
3) My family misses out because of my work commitments								
4) My work has a negative impact on my family life								
5) Working often makes me irritable or short tempered at home								

## 요약 (국문 초록)

### 장시간 노동과 근로자의 우울 증상과의 관계에서 일-가족 갈등의 역할: 성별층화 분석으로

서울대학교 보건대학원  
환경보건학과 환경보건학전공  
이 가 린

**서론:** 장시간 노동과 일-가족 갈등은 모두 근로자의 건강을 해치는 것으로 알려져 있다. 그러나 일-가족 갈등이 장시간 노동과 우울 증상의 관계에서 어떻게 작용하는지에 대한 실증적인 연구는 거의 이루어지지 않았다. 따라서 본 연구에서는 성별 계층화 분석으로 한국 근로자의 장시간 노동과 우울 증상의 관계에서 일-가족 갈등이 어떤 역할을 하는지를 알아보았다.

**방법:** 한국의 국가 대표성을 가지는 데이터인 제6차 한국근로환경조사 (Korean Working Conditions Survey, KWCS)를 분석하였다. 연구대상은 주당 근로시간이 40시간 이상인 교대근무를 하지 않는 임금근로자로 한정하여 20,282명이 분석에 포함되었다. 일-가족 갈등은 KWCS의 세 가지 문항으로 측정하였으며, 우울 증상은 WHO-5를 이용하여 측정하였다. 매개효과를 추정하기 위해 Baron과 Kenny 방법, Sobel test, bootstrapping을 이용한 분석을 사용하였다. 교호작용(effect modification)을 확인하기 위해 일-가족 갈등으로 층화 하여 분석을 실시하고 장시간 근무와 일-가족 갈등과 장시간 노동 사이 상호작용 효과를 P-value로 추정하여 유의성을 평가하였다. 모든 추정모델은 연령, 학력, 가족 중 18세 미만 아동의 여부, 고용형태, 직종, 월수입, 회사규모 등을 고려하여 시행되었다.

**결과:** 장시간 노동(주 52시간 이상 근무)의 유병률은 남성은 12.1%, 여성은 8.4%였다. Baron과 Kenny 방법, Sobel test, bootstrapping에 의한 매개분석으로 확인한 매개효과는 남성과 여성 모두에서 통계적으로 유

의하였다. 교호작용효과로 남성(PR: 1.70, 95% CI: 1.54, 1.89)과 여성(PR: 1.70% CI: 1.49, 1.93) 모두 장시간 근로와 일-가정 갈등이 모두 있는 근로자가 장시간 근로와 일-가정 갈등이 모두 없는 근로자보다 우울 증상이 더 높았다.

**결론:** 일-가족 갈등은 장시간 노동과 근로자의 우울증상 사이에서 매개효과와 교호작용효과가 있다.

**키워드:** 장시간 노동, 우울 증상, 일-가정 갈등, 매개효과, 교호작용효과, 성별 계층화

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