ORIGINAL PAPER

THE RELATIONSHIP BETWEEN WORKING TIME MISMATCH AND DEPRESSION ACCORDING TO ACTUAL HOURS WORKED

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Abstract

Objectives: The effect of the combination of working hours and working time mismatch on depression is unknown. This study was undertaken to confirm the relationship between working time mismatch and depression with respect to hours worked. **Material and Methods:** The data of 45 514 adult workers that participated in the *6th Korean Working Conditions Survey* (KWCS-VI 2020) were reviewed. Depression was defined using the *World Health Organization 5 Well-Being Index* (WHO-5) cut-off score of 50. Working time mismatch was defined as a difference between actual and desired working hours. To identify associations between working hour mismatch and depression according to weekly hours worked, stratification analysis was conducted by dividing the study subjects into 3 groups based on actual hours worked weekly (<40 h, 40–<52 h, or ≥52 h). Multiple logistic regression analysis adjusted for potential confounders was performed to calculate odds ratios of depression. **Results:** In the <40 h, 40–<52 h, and ≥52 h groups, the odds ratios (OR) of working more hours than desired were 1.51, 95% CI: 1.20–1.92 (<40 h), 1.70, 95% CI: 1.58–1.84 (40–<52 h), and 1.55, 95% CI: 1.41–1.69 (≥52 h), respectively, compared to a matched actual versus desired working hours group (the matched group). On the other hand, the odds ratios of working fewer hours than desired were 1.17, 95% CI: 1.07–1.27 (<40 h), 1.38, 95% CI: 1.20–1.60 (40–<52 h), and 1.98, 95% CI: 1.24–3.17 (≥52 h), respectively. The risk of depression was found to increase significantly with working time mismatch within all 3 working hour groups. **Conclusions:** Working time mismatch increases the risk of worker depression regardless of hours worked. Int J Occup Med Environ Health. 2023;36(6):788–97

Key words:
depression, mismatch, overemployment, underemployment, working time, working time mismatch

INTRODUCTION

The relationship between long working times and health status has been studied for decades [1–3]. Evidence that adverse health effects such as cardiovascular or mental health disorders occur in those that work longer has been adequately presented by meta-analysis [4,5]. Today considerations of work-life balance constitute a global trend, but although average working time is decreasing in South Korea, we still have the 4th longest mean working time among OECD countries [6]. As a result, Korean worker well-being, especially regarding mental health, is an active research topic [7–9]. Among others, depression is one of the most common mental illnesses and a major cause of absenteeism in many countries [10]. Depression causes reduced work productivity and represents an indirect economic burden at the national level [11]. In a study based on the survey of Korean workers aged 16–64 years, 76.7% of participants answered that they experienced

low mood or sadness, and 7.4% had been diagnosed with depression by a doctor, indicating that the diagnosis rate of depression was very low. In addition, the fact that only 31% of workers with diagnosis of depression took sick leaves and the absent days were much shorter than in other countries suggests that presenteeism caused by depression might be a more serious problem than absenteeism in Korea [12].

In a study that analyzed working time in OECD member countries, working time mismatches were found to increase despite reductions in actual time worked [13]. Researcher's interests have shifted towards the effect of overemployment (working more than desired hours) and underemployment on individuals well-being, based on the fact that each worker's desired working hours is different [14]. Also in South Korea, the number of studies performed on working time mismatch and resultant health problems has increased recently, and studies have reported that working time mismatch is related to subjective well-being, stress, and depression [15,16] and that individuals with larger working time mismatch are at greater risk of depression [17,18].

A study based on the panel survey data from Australia and Germany suggested that in regard to workers' mental health, working time mismatch should be considered more than actual working hours [19]. The researchers found certain evidence that overemployment adversely affect the mental health of workers in both Germany and Australia and discordant results in underemployment between 2 countries which need additional evidence of follow-up studies from other region. However, there are few studies that have confirmed the association between working time mismatch and depression, while considering the actual working hours. Working hours per week and working time mismatch are known to affect depression, respectively [8,17,18]. Accordingly, this study was performed to determine relationships between working time mismatch and depression stratified by weekly working hours.

MATERIAL AND METHODS
Participants
In the present study, the authors used data from the *6th Korean Working Conditions Survey* (KWCS-VI 2020) provided by the Occupational Safety and Health Research Institute (OSHRI). The survey was conducted in October 2020–April 2021 on a total of 50 205 respondents selected by secondary probability proportion stratified cluster sampling from among all South Korean aged ≥15 years. In current study, only workers who satisfied all of the following conditions were defined as adult workers:
– legal age of majority (≥20 in Korean age),
– single job,
– paid worker (including both wage worker and self-employed).

Of the 50 538 respondents initially selected for the study, 153 aged ≤19 years, 504 engaged in ≥2 occupational activities, 1558 unpaid workers (including housewives), and 2809 with missing values and outliers for required variables were excluded. Thus, this study was performed using the data of 45 514 adult workers (Figure 1).
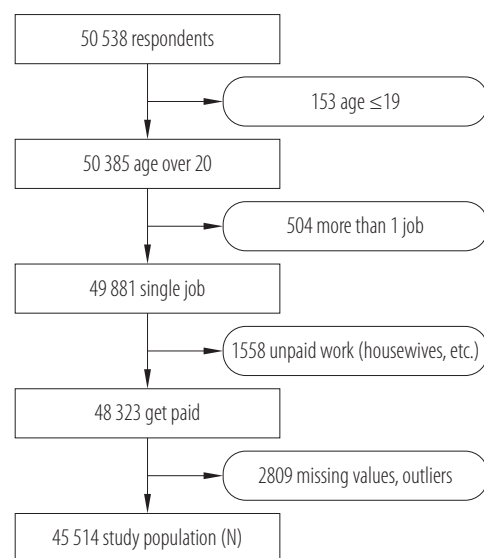

Figure 1. Flow diagram of the participant selection process – study based on the 6th Korean Working Conditions Survey (KWCS), October 2020–April 2021, South Korea

Sociodemographic and socioeconomic status information

General characteristics included in previous studies, including sex, age, income, education level, and occupation, were included in questionnaires. Occupations were classified as blue-collar group (machine operator, production workers), pink-collar group (service industry, sales), and white-collar group (professional occupation, office worker). In addition, subjects were divided into self-employed and wage workers. As previous studies have shown that outdoor activities during leisure times have a positive effect on preventing depression [20], these activities were classified as sometimes to always or rarely to never.

Measures

Depression

Since its first publication in 1998, the *World Health Organization 5 Well-Being Index* (WHO-5) questionnaire has been commonly used to assess subjective psychological well-being. Respondents are asked to rate the following 5 statements based on experience of the previous 14 days: 1) "I felt cheerful and in good spirits," 2) "I felt calm and relaxed," 3) "I felt active and vigorous," 4) "I wake up feeling fresh and rested," and 5) "My daily life is filled with things that interest me."

Each of these 5 items was scored from 5 (all of the time) to 0 (none of the time). Thus, cumulative scores theoretically ranged from 0 (absence of well-being) to 25 (maximal well-being). Because scales that measure health-related quality of life are conventionally translated to percentages (where 100% represents maximal well-being), cumulative scores were multiplied by 4.

In 2015 a systematic review was performed on an extensive body of WHO-5 literature to determine whether WHO-5 could be used as a screening tool for depression and to assess its applicability across study fields. In most of the studies included a WHO-5 score of ≤50 was used to assign a "screening diagnosis" of depression. For the 18 studies that used this cut-off criterion, WHO-5 had a sensitivity of 0.86 and a specificity of 0.81 vs. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. (DSM-IV) depression, which was used as the gold standard. Thus, WHO-5 with this cut-off was found to have adequate validity as a screening tool for depression [21].

Working time mismatch

To define the key independent variable "working time mismatch," self-reported survey data were used. Respondents were asked, "How many hours a week do you actually work?" and "If you could freely choose how long you work, how many hours a week would you like to work, given that you have to make a living?" Answers were designated as "actual working times" and "desired working times," respectively, and lunch and commuting times were excluded. "Working time mismatch" was defined as the difference between these 2 values. "Overemployment" and "underemployment" were used to describe working more or less, respectively, than desired working times.

Statistical analysis

Initially, a χ^2 test was used to compare different proportions with depression with respect to general characteristics. Next, multiple logistic regression analysis was performed to assess risks of depression by adjusting for potential confounders using factors by initial analysis as control variables. Odds ratios (ORs) were calculated to evaluate correlations between actual working time and depression using 3 different models. Additionally, while examining the relationship between working time mismatch and depression, stratification analysis was conducted by dividing the study subjects into 3 different weekly working time groups (<40 h, 40–<52 h, and ≥52 h). The statistical analysis was performed using R for Windows (v. 4.2.0 R Foundation for Statistical Computing, Vienna, Austria). Null hypotheses of no difference were rejected when p-values were <0.05.

RESULTS

Relationship between general characteristics and depression

Statistical differences were found for several variables when proportions of study subjects with depression were compared (Table 1). The χ² test was used to identify differences between proportions with depression in all subgroups. Results showed that the proportion with depression increased with age and that higher income and higher final educational background level were significantly associated with lower proportions of depression. Furthermore, self-employed workers were more depressed than wage workers. Regarding job classifications, blue-collar workers were most likely to be depressed, followed by pink- and white-collar workers, and for outdoors activities, those that enjoyed these activities were less depressed than those who did not (rarely or never).

Depression proportions and working time mismatches for weekly working hours

The statutory working week in Korea is 40 h, and the maximum permissible is 52 h when overtime work is included (Figure 2). The subjects were divided into 8 groups according to weekly working hours at interval of 6 h, and calculated average proportions of depression in each group. Compared to other groups, the groups with the weekly working hours within statutory range had the lowest proportion of depression. Those that worked 40–46 h/week had the lowest proportion of depression (28.2%), followed by those that worked 46–<52 h/week (33.1%). Among groups with the working time ≥52 h/week, those who work more had higher proportions of depression. On the contrary, among groups <40 h/week of working time, those who work less had higher proportions of depression.

The authors then analyzed relations between actual working time and working time mismatches. The percentages of subjects in the matched, overemployed, or underemployed working time groups were calculated (Figure 3). In the mosaic plot above, areas of rectangles represent numbers of individuals. As was expected, most of the study subjects were in the 40–46-hour or 46–52-hour groups. The percentage of working time-matched individuals was highest in the 40–46-hour group (88.2%) and lowest in the ≥64-hour group (48.2%). The percentage of underemployed people was the highest in the <28-hour group (41.0%), and percentages decreased with time worked. The percentage of overemployed people was lowest in the <28-hour group (2.3%), increased with time worked, and was highest in the ≥64-hour group (51.5%).

Risks of depression (OR)

The authors analyzed whether times worked affected the risk of depression using different models (Table 2). Figure 2 above shows that depression proportions were affected by working time. For this analysis, the 40–<52-weekly working hour group was used as a reference group and the <40-hour and ≥52-hour groups. Crude ORs were calculated as model 1. In model 2, covariates listed in Table 1 were used to produce an adjusted model. Model 3 included one more variable (whether working time was matched or mismatched) than model 2. Model 1 showed that the risk of depression was significantly higher in the <40-hour and ≥52-hour groups (ORs 1.61 and 1.60, respectively). However, model 2 produced ORs of 1.07 and 1.40, respectively, which were still statistically significant. Finally, model 3 resulted in further decreases in ORs in the <40-hour and ≥52-hour groups (to 0.98 and 1.26, respectively), though the difference remained significant in the ≥52 group.

Working time mismatch and depression

Finally, the degree to which working time mismatch affected the risk of depression (Table 3) was investigated in

Table 1. General characteristics and proportions with depression among the study subjects – study based on the *6th Korean Working Conditions Survey* (KWCS), October 2020–April 2021, South Korea

Variable	Participants (N = 45 514)		p
	total [n (%)]	with depression [%]	
Sex			0.671
male	21 877 (48.1)	33.8	
female	23 637 (51.9)	33.6	
Age			<0.001
20–29 years	4331 (9.5)	24.5	
30–39 years	8025 (17.6)	28.0	
40–49 years	10 124 (22.2)	30.5	
50–59 years	11 327 (24.9)	33.9	
≥60 years	11 707 (25.7)	43.7	
Monthly income			<0.001
KRW <200 000	14 746 (32.4)	41.7	
KRW 200 000–<300 000	14 336 (31.5)	31.8	
KRW 300 000–<400 000	9291 (20.4)	29.2	
KRW ≥400 000	7141 (15.7)	27.1	
Education			<0.001
middle school or lower	7239 (15.9)	50.0	
high school	16 867 (37.1)	35.2	
college or higher	21 408 (47.0)	27.1	
Employment type			<0.001
wage worker	30 992 (68.1)	31.6	
self-employed	14 522 (31.9)	38.4	
Job classification			<0.001
white collar	15 498 (34.1)	26.8	
pink collar	13 732 (30.2)	33.2	
blue collar	16 284 (35.8)	40.7	
Outdoor activity			<0.001
sometimes to always	17 339 (38.1)	25.6	
rarely or never	28 175 (61.9)	38.8	
Working time [h]			<0.001
<40 h/week	10 305 (22.6)	40.1	
40–<52 h/week	27 122 (59.6)	29.4	
≥52 h/week	8087 (17.8)	40.0	

Variable	Participants (N = 45 514)		p
	total [n (%)]	with depression [%]	
Working time mismatch			<0.001
matched	33 504 (73.6)	31.0	
mismatched	12 010 (26.4)	41.5	

p – χ² test.

all study subjects and in the <40-hour, 40–<52-hour, and ≥52-hour groups. The χ² test was applied to the matched, underemployed, and overemployed groups, and then logistic regression analysis was used to calculate the odds ratios of being underemployed or overemployed using the matched group as a reference. Initially, proportions with depression and crude ORs were calculated and then performed analysis using model 2 (the adjusted model). For all study subjects, proportions with depression were higher in the mismatched (under employed or overemployed) groups than in the matched group. The underemployed group had an OR (95% CI) of 1.21 (1.14–1.30), and the overemployed group had an OR (95% CI) of 1.71 (1.62–1.80). Stratification analysis also showed the risk of depression was significantly higher in the mismatched
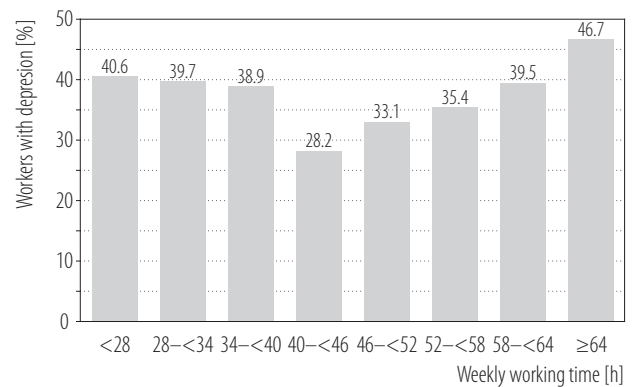

Figure 2. Proportions of workers with depression according to weekly working hours – study based on the *6th Korean Working Conditions Survey* (KWCS), October 2020–April 2021, South Korea
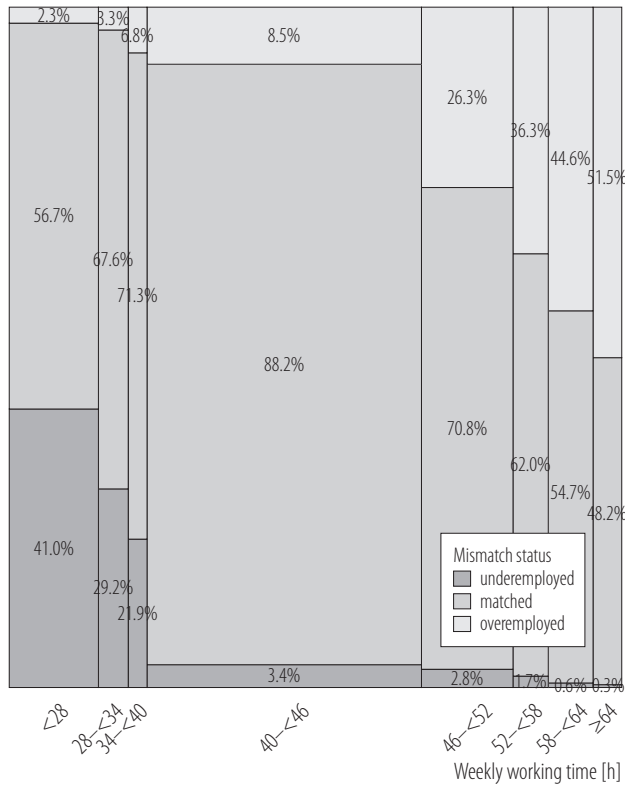
Figure 3. Actual working times and working time mismatch distributions – study based on the *6th Korean Working Conditions Survey* (KWCS), October 2020–April 2021, South Korea

DISCUSSION

This study was undertaken to determine whether actual working time and working time mismatch, individually or in combination, affect the risk of depression among Korean workers. It was found that the risk of depression was significantly dependent on working time mismatch in the <40-hour, 40–52-hour, and ≥52-hour groups. Furthermore, working time mismatch factor weakened the strength of the correlation between actual working time and depression.

The authors' results showed that longer working hours are associated with poorer worker mental health, which agrees with previous studies [8,9]. Furthermore, a large-scale meta-analysis based on the 28 prospective cohort studies in 35 countries empowered that long working hours increase the risk of depression and that this association was stronger in Asian countries [22]. Although the effects of short working times on depression remains controversial, it has been argued that it has no significant effect on worker mental well-being or an adverse effect [23,24]. In these research however, the confounding effect of mismatch between actual and desired working times was not considered. As the present study shows, excessively long or short working times tend to increase the possibility of working time mismatch. In the current study, the authors adjusted the model by using several covariates including whether working time mismatch exists to find out the risk of depression according to actual working time. As a result, the strength of the correlation between actual working

group than in the matched group. However, contrary to expectation, in the ≥52-hour group, the OR (95% CI) of depression among the underemployed was higher than that for the overemployed (1.98 [1.24–3.17] vs. 1.55 [1.41–1.69], respectively).

Table 2. Odds ratios (OR) of depression by actual working time in the 3 adjusted models – study based on the *6th Korean Working Conditions Survey* (KWCS), October 2020–April 2021, South Korea

Participants working time	OR (95% CI)		
	model 1	model 2	model 3
40–<52 h/week	1	1	1
<40 h/week	1.61 (1.53–1.69)	1.07 (1.01–1.03)	0.98 (0.92–1.04)
≥52 h/week	1.60 (1.52–1.69)	1.40 (1.32–1.48)	1.26 (1.19–1.34)

Model 1 – crude; model 2 – adjusted for sex, age, income, education, employment status, physical activity, job category, and outdoor activity; model 3 – model 2 + adjusted for working time mismatch.

Table 3. Relationships between working time mismatch and depression in all study subjects and the <40-hour, 40–52-hour, and ≥ 52-hour groups – study based on the *6th Korean Working Conditions Survey* (KWCS), October 2020–April 2021, South Korea

Variable	Participants (N = 45 514)		p	OR (95% CI)	
	total [n (%)]	with depression [%]		crude	adjusted*
Total					
matched	33 504 (73.6)	31.0	<0.001	1	1
underemployed	4645 (10.2)	40.1		1.49 (1.40–1.59)	1.21 (1.14–1.30)
overemployed	7365 (16.2)	42.3		1.65 (1.55–1.72)	1.71 (1.62–1.80)
Working time					
<40 h/week					
matched	6291 (61.0)	39.5	0.025	1	1
underemployed	3693 (35.8)	40.7		1.05 (0.97–1.14)	1.17 (1.07–1.27)
overemployed	321 (3.1)	46.7		1.34 (1.07–1.68)	1.51 (1.20–1.92)
40–<52 h/week					
matched	22 733 (83.8)	27.7	<0.001	1	1
underemployed	879 (3.2)	36.6		1.51 (1.31–1.74)	1.38 (1.20–1.60)
overemployed	3510 (12.9)	39.0		1.67 (1.55–1.80)	1.70 (1.58–1.84)
≥52 h/week					
matched	4480 (55.4)	35.8	<0.001	1	1
underemployed	73 (0.9)	50.7		1.85 (1.16–2.93)	1.98 (1.24–3.17)
overemployed	3534 (43.7)	45.2		1.48 (1.36–1.62)	1.55 (1.41–1.69)

p – χ^2 test.

* Adjusted for sex, age, income, education, employment status, physical activity, job category, outdoor activity.

time and depression gradually weakened as compared with the crude model. In the <40-hour group, a non-significant opposite result was obtained (OR = 0.98). These findings show that if working time mismatch is not considered, determined relationships between actual working time and depression can be erroneous.

Research on the relationship between working time mismatch and worker mental health has received more attention recently [13,19]. The authors found that working time mismatch has a significant effect on the risk of depression. Analysis of all study subjects showed that the mismatched group had a higher depression proportion than the matched group and that the overemployed

group had a higher risk of depression than the underemployed group. A more detailed analysis was performed by stratifying study subjects into 3 working time groups, and similar results were obtained with the exception of the opposite result for those that worked ≥52 h/week. This observation suggests workers feel more depressed when underemployed than when overemployed, which is related with the findings of previous studies, which showed overworking increases the risk of workaholism [25]. Workaholics tend to regard themselves as underemployed, hoping for more working hours. The negative effects of workaholism on psychological well-being have been studied for decades, and according to a study con-

ducted in Japan, the risk of depression increases proportionally as the degree of workaholism increases [26]. Standard measure of workaholism have not yet been established worldwide, but according to researchers who recently developed Korean version of *Workaholism Analysis Questionnaire* (K-WAQ), the prevalence of workaholism in Korea is about 39.7%, showing a higher level than other countries [27]. This can be attributed to the fact that in Korea, which has undergone rapid economic growth since the 1960s, a work-oriented system was established throughout society, and Koreans have been educated on the values of diligence and competition. However, limitation in the number of individuals included (N = 54) may cause uncertain interpretations, leading to a need for follow-up studies.

The strength of this study is that a large number of cases were investigated, and that the data used was obtained from the Occupational Safety and Health Research Institute (OSHRI),and thus, highly reliable, based on the subject selection procedure and the survey method (one-on-one interview by investigators) and sample design and extraction procedures used. The questionnaire addressed many demographic characteristics and investigated in-depth occupational and non-occupational activities, which enabled the authors to confirm relationships between sex, age, education level, occupation, income level, self-employment, and outdoor activities and the prevalence of depression and to establish an adjusted model that allowed the authors to explore relationships between working hours and depression. Moreover, many previous studies focused on only 1 factor (actual working time or working time mismatch), while in this study the interaction of both factors was analyzed.

Nonetheless, this study has some limitations. First, the data used were obtained using a self-report questionnaire, and thus, self-report bias cannot be excluded. Also, no qualitative evaluation was performed because depression was defined in this study based on an arbitrary WHO-5 well-being index score cut-off of 50 pts, not on psychiatrist-derived diagnoses. Finally, the study is inherently limited by its cross-sectional design, which prevented the authors' investigating longitudinal changes in the symptoms of depression.

CONCLUSIONS

In this study, the authors examined how actual working time and working time mismatch each and conjointly affect the risk of depression among Korean workers. The risk of depression was found to increase when actual weekly working times were <40 h/week or ≥52 h/week. However, adjusting for potential confounder diminished this effect. On the other hand, working time mismatch increased the risk of depression regardless of hours worked. Therefore, to improve worker mental health and to ensure proper working hours, it is important to consider the differences of working time mismatch of each individual worker.

Author contributions

Research concept: Ji Ho Kim, Shin Goo Park

Research methodology: Ji Ho Kim, Hwan Cheol Kim, Sang Hee Hwang

Collecting material: Ji Ho Kim

Statistical analysis: Ji Ho Kim, Shin Goo Park

Interpretation of results: Ji Ho Kim, Shin Goo Park

References: Ji Ho Kim, Shin Goo Park

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