

## Research paper

# Long working hours and depressive symptoms: moderation by gender, income, and job status

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## ABSTRACT

**Background:** Long working hours can be a risk factor for poor mental health; however, little is known about the potential factors moderating their relation. This study investigates the association between working hours and depressive symptoms, and explores the potential moderating effect of gender, income level, and job status on this association using a nationally representative sample of working population in South Korea.

**Methods:** Data of 7,082 workers aged 19 years or above were obtained from the Korea National Health and Nutrition Examination Surveys (KNHANES) conducted in 2014, 2016, and 2018 in South Korea. Working hours were categorized into 35–39, 40, 41–52, 53–68, and  $\geq 69$  hours/week. Depressive symptoms were evaluated using the Patient Health Questionnaire-9 (PHQ-9).

**Results:** Individuals working  $\geq 69$  hours/week were more likely to have moderate to severe depressive symptoms compared to those working 40 hours/week. The association between longer working hours and depressive symptoms was especially prominent in female workers, standard wage workers, and workers with low income levels. We observed significant partial mediation pathways between working hours and PHQ-9 scores through both perceived usual stress level and self-rated health in the total sample.

**Limitations:** The cross-sectional design of the study limits causal interpretation of the findings.

**Conclusion:** Working longer than the legal upper limit of 52 hours/week puts workers at a greater risk for depression. Females, low-income workers, and wage workers are more vulnerable to the negative consequences of long working hours on mental health.

## 1. Introduction

Work is a crucial element in fulfilling life, as it helps individuals to not only make ends meet but also find meaning in life (Cummins, 2005; Steger et al., 2009). People who are satisfied with their careers tend to have higher self-esteem and lower anxiety (Deci et al., 2001) and depression (Bluen et al., 1990). However, excessively long working hours may hurt the potential beneficial effects of working. Indeed, previous research has documented that long working hours have been linked to both poor physical health, such as increased risk of stroke or coronary heart disease (Kivimäki et al., 2015), and psychological health,

such as depression or anxiety (Virtanen et al., 2011).

The present study focused on the association between working hours and depression, one of the most common psychiatric illnesses among employees in many countries, including Korea (Wulsin et al., 2014; Yoon, 2020). Korea is a particularly important case because, according to a recent analysis, the prevalence of probable depression among employees in Korea is higher than in other societies, such as Europe or the United States (Park et al., 2016). A possible factor proposed by researchers to explain the poor mental health of Korean employees is the long working hours, as they work significantly longer hours than their counterparts in any other country. For instance, while 14.8% of the

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employees across 34 European countries worked longer than 48 hours per week (Schütte et al., 2014), the Korean equivalent was as high as 45.3% (Park et al., 2016). In fact, Korea's average working hours are one of the highest among the member states of the Organisation for Economic Cooperation and Development (OECD, 2020).

However, empirical evidence on the role of long working hours as a potential factor for depression among employed individuals remains inconclusive. Recent systematic reviews and meta-analyses have yielded inconsistent results; generally, the effect of long working hours on depression is small, if not negligible (Bannai and Tamakoshi, 2014; Sparks et al., 1997; Van der Hulst, 2003; Virtanen et al., 2011; Watanabe et al., 2016). The inconsistent associations between working hours and depression reported in previous studies may be related to several limitations of prior research.

First, previous studies have predominantly examined developed nations in the West, such as Europe and North America. Given that overtime work is more prevalent in Asian countries, such as Japan and Korea, more empirical evidence from non-Western societies such as Korea will more accurately demonstrate the association between long working hours and mental health. Second, situational or boundary factors such as demographic, socioeconomic, and job characteristics of individuals may moderate the relationship between working hours and depression. That is, some groups of people might be more or less vulnerable to the detrimental consequences of long working hours than others. For example, women may be more affected by overtime work than men because women are more likely to be responsible for household chores and childcare. Therefore, women would experience greater work–family conflicts than men (Frone, 2000; Frone et al., 1996), which in turn would lead to a greater likelihood of depression (Shimazu et al., 2009). However, only a few studies have taken gender into account (Shields, 1999; Virtanen et al., 2018). Another group that may be particularly vulnerable to the negative effects of overtime work is individuals with low incomes. Because people with low income have less control over resources (Kraus et al., 2012), the negative effect of overtime work on depression could become greater. Finally, job status, such as the distinction between standard wage, non-standard wage, and self-employed/employer, was not considered in previous research. Considering that characteristics such as job stability or degree of autonomy vary depending on job status, they may affect the impact of overtime work on depression (Watanabe et al., 2016).

Given the limitations of previous research, the present study had the following goals. We aimed to investigate the relationship between working hours and depression among using a nationally representative sample of Korean workers, who have been ranked high in terms of working hours among OECD countries in recent years. In addition, we tested for the possible role of overtime work on suicidality, as work-related suicides are becoming more common worldwide (Amagasa et al., 2005; Younès et al., 2018). We further tested the moderators including gender, income level, and job status, which could potentially explain the differential associations between working hours and depression/suicidality.

## 2. Methods

### 2.1. Study sample

We obtained data from a nationwide cross-sectional survey, the Korea National Health and Nutrition Examination Surveys (KNHANES), conducted in 2014, 2016, and 2018 in South Korea. The KNHANES has been conducted annually by the Korea Centers for Disease Control and Prevention since 2007. The survey investigates public health, nutritional status, and socioeconomic, health-behavioral, and environmental determinants across the South Korean population (Kim, 2014). We used data from the KNHANES in 2014, 2016, and 2018 because the survey has been evaluating the depressive symptoms of respondents biennially using the Patient Health Questionnaire-9 (PHQ-9) since 2014. In the

KNHANES, a stratified, multi-stage, clustered sampling design was adopted to obtain a systematic and representative sample (Kweon et al., 2014). The survey includes a new and independent sample of approximately 10,000 people annually from 192 Primary Sampling Units (PSUs); each PSU is selected using a sampling frame of all census blocks containing South Korean national resident registration addresses (Kweon et al., 2014). Detailed information on stratified multi-stage clustered sampling has been provided in previous studies (Kim, 2014; Kweon et al., 2014). The survey was conducted by well-trained interviewers using semi-structured and self-administered questionnaires. Among 23,692 people who participated in KNHANES 2014, 2016, and 2018, 18,847 were aged 19 years or above. Further, among the 10,028 people who were wage workers, unpaid family workers, or self-employed/employer, 7,195 worked full-time (35 hours or more per week); those who worked less than 35 hours per week ( $n = 2,833$ ) were excluded based on the criteria used in previous studies (Kivimäki et al., 2015; Virtanen et al., 2011; Yoon et al., 2018). From among these, 7,082 individuals were enrolled after excluding the 113 respondents who had missing values for the following variables (Fig. 1): working hours ( $n = 13$ ), PHQ-9 score ( $n = 15$ ), education level ( $n = 2$ ), household income level ( $n = 12$ ), marital status ( $n = 3$ ), job type ( $n = 16$ ), shift work ( $n = 13$ ), alcohol consumption ( $n = 28$ ), smoking ( $n = 30$ ), exercise ( $n = 15$ ), and body mass index (BMI,  $n = 13$ ). The KNHANES dataset is publicly available (<https://knhanes.cdc.go.kr/knhanes/main.do>), and all respondents provided informed consent for survey data to be used for research purposes before participating in the survey. The protocol of the present study was approved by the ethics committee of the Korea University Anam Hospital (2020AN0258).

### 2.2. Assessment of working hours

Working hours were measured using the following question: “How many hours do you usually work per week, including overtime?” (Lee et al., 2020). In the present study, we used two types of categorical variables regarding working hours in the main and subgroup analyses. In the main analysis, working hours were categorized into 35–39, 40, 41–52, 53–68, and  $\geq 69$  hours/week reflecting working conditions of South Korean workers (Yoon et al., 2018). As for categorization (Yoon et al., 2018), the Korean Labor Standards Act sets 40 hours per week (i.e., 8 hours/day) as legal working hours, and overtime of up to 12 hours/week is allowed according to this legislation (i.e., 52 hours/week). However, many people work up to 68 hours/week in South Korea, as 16 hours of work on weekends is not recognized as illegal overtime according to the government's interpretation of the act. Additionally, the act enables workers in several industries (such as the airline, overland transportation, and healthcare sectors) to work over 68 hours per week. In the sub-group analysis, the working hours were re-categorized into 35–40, 41–52, and  $\geq 53$  h/week due to a decreased sub-sample size. Further, this 3-level categorical variable is comparable to variables of working hours used in previous studies in other countries (i.e., Japan, Canada, or European nations), in which extremely long working hours (i.e.,  $\geq 69$ h/week) might not be common (Virtanen et al., 2018; Watanabe et al., 2016).

### 2.3. Psychometric measurements

Depressive symptoms were evaluated using a 9-item version of PHQ-9, which is one of the most widely used scales for depression in primary care settings (El-Den et al., 2018). The PHQ-9 assesses depressive symptoms during the most recent two-week period based on the DSM-IV criteria for a major depressive episode (Kroenke et al., 2001). Each item measures the frequency of depressive symptoms using a four-point Likert scale ranging from 0 to 3 (0 = not at all; 1 = several days; 2 = more than half the days; 3 = nearly every day). The Korean version of the PHQ-9 has high internal consistency validity (Han et al., 2008; Shin et al., 2020). In the present study, Cronbach's  $\alpha$  of the PHQ-9 score was

## Flow chart for selection of the participants in the analysis

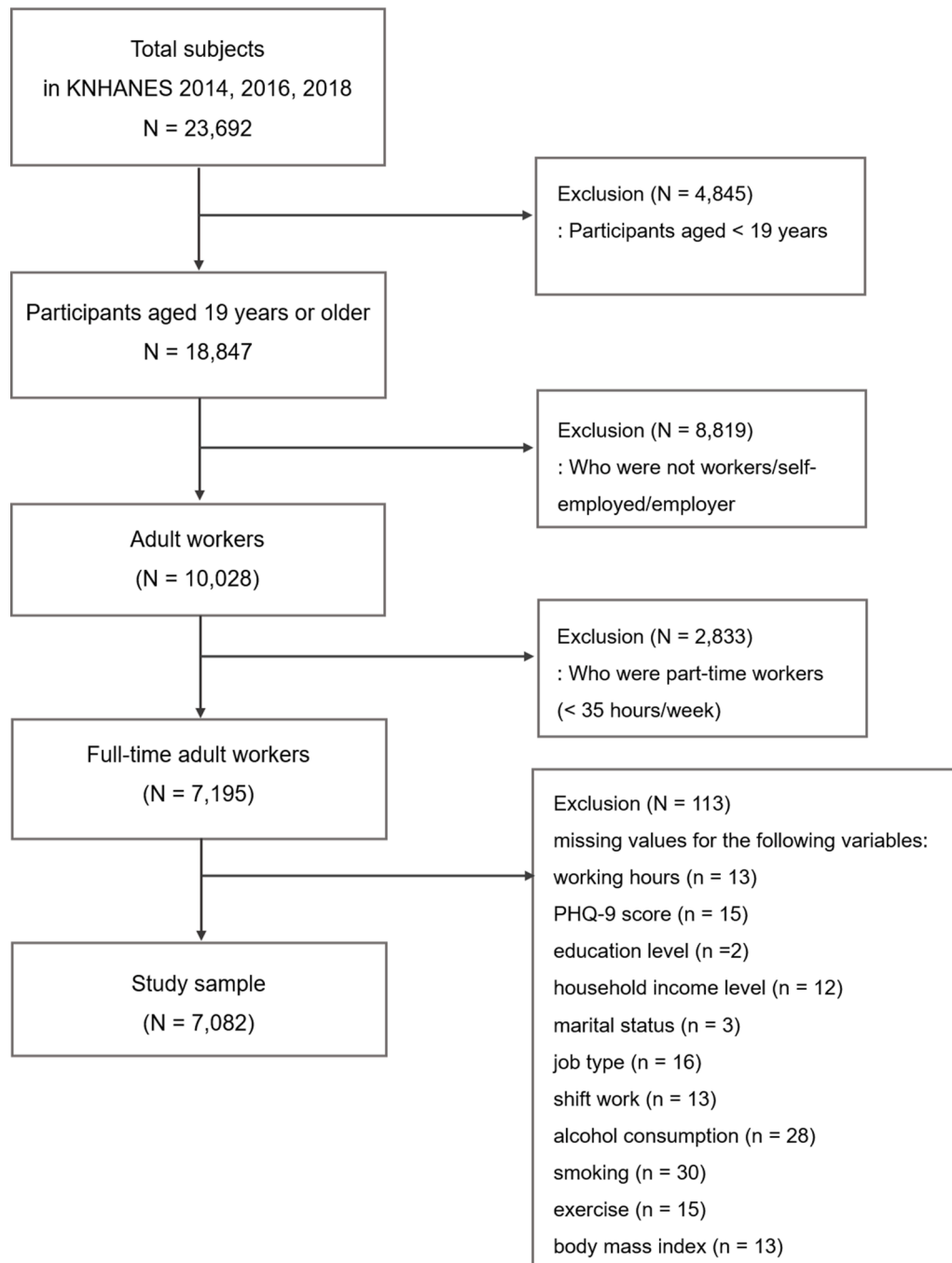


Fig. 1. Flow chart for selection of the participants in the analysis.

0.760. We considered PHQ-9 scores of 10 or above and 5–9 as indicating moderate to severe and mild depressive symptoms, respectively, according to previous studies (Kroenke and Spitzer, 2002; Kroenke et al., 2001). Non-depressed workers were defined as those who scored 4 or below on the PHQ-9 (Kroenke and Spitzer, 2002; Kroenke et al., 2001).

Presence of suicidal ideation was assessed using the 9th item of the PHQ-9, “How often have you been bothered by thoughts that you would be better off dead or hurting yourself in some way?”, and a response of 1 or above indicated the presence of suicidal thoughts (Han et al., 2019). Suicidal thought has been widely assessed using the 9th item of the PHQ-9 in previous studies (Bauer et al., 2013; Simon et al., 2013; Walker et al., 2011).

Perceived usual stress was assessed with the following single question rated on a 4-point Likert scale (Han et al., 2018a): “How much stress do you usually feel in your daily life? (‘Very high,’ ‘High,’ ‘Low,’ or ‘Little’).” Self-rated health (SRH) was evaluated using a single-item rated on a five-point Likert scale (Han et al., 2019). In the present study, SRH was re-categorized into “Good” (merged ‘Very good’ and ‘Good’), “Fair,” and “Bad” (merged ‘Very bad’ and ‘Bad’) due to low frequencies in both the extreme responses.

### 2.4. Covariates

The following sociodemographic and health-related characteristics

were included as covariates to control their effects as confounding factors: age, gender, education level, equivalent monthly household income level (income  $\leq$  the first quartile [Q1]; Q1 < income  $\leq$  the second quartile [Q2]; Q2 < income  $\leq$  the third quartile [Q3]; income > Q3), marital status, residential region, job status (standard wage workers, non-standard wage workers, non-paid family workers, and self-employed/employer), job type (white collar, pink collar [i.e., service or sales workers], blue collar), presence of shift work, number of chronic diseases, alcohol consumption, cigarette smoking, BMI, and physical activity. Detailed information regarding the categorization of these variables is presented in Table 1. The equivalent monthly household income was determined by dividing the raw monthly household income by the square root of family size (Han et al., 2017), and the quartiles of the income level were determined based on the statistics of the entire sample ( $n = 23,692$ ) in KNAHES 2014, 2016, and 2018. For morbidity of chronic disease, diagnoses of 24 chronic diseases (Table S1) by a physician were investigated. Engagement in physical activity was determined by the following criteria: i) medium-intensity aerobic physical activity at least 2.5 h/week or ii) high-intensity aerobic physical activity at least 1.25 h/week.

### 2.5. Statistical analyses

A multinomial regression analysis was conducted including working hours (i.e., 35–39, 40, 41–52, 53–68, and  $\geq 69$  h/week) as the independent variable (IV), depressive symptoms and suicidal ideation as the dependent variables (DVs), and all socioeconomic and health-related variables (i.e., age, gender, education level, household income, marital status, residential region, job status, job type, shift work, chronic disease, alcohol consumption, smoking, physical activity, and BMI) as covariates. To explore the moderating effect of gender, income level, and job status, logistic regression analyses were performed on subgroups determined by these three factors. The analyses also included the aforementioned socioeconomic and health-related variables as covariates. In the subgroup analyses, the working hours were re-categorized into 35–40, 41–52, and  $\geq 53$  h/week due to decreased sub-sample sizes, and the income level was classified as high (income > Q2) and low (income  $\leq$  Q2) groups. For the subgroup analyses on job status, non-paid family workers were excluded due to their small sample size. Additionally, linear regression analyses, including working hours (as a continuous variable), all socioeconomic and health-related variables as IVs, and PHQ-9 score as a DV, were performed on the total sample and the sub-groups. Finally, as a secondary analysis, we explored the mediating effects of perceived usual stress and SRH in the association between working hours and PHQ-9 score using the mediation analysis method by Hayes and Preacher (2014). In the mediation model, working hours (as a continuous variable) and PHQ-9 score were included as IV and DV, respectively, and the aforementioned socioeconomic and health-related variables were included as covariates. For mediation analyses, the PROCESS macro (ProcessV2.16.3) program (<http://www.processmacro.org/download.html>) developed by Hayes and Preacher was used. The program provides an indirect effect of potential mediators using a nonparametric resampling bootstrapping procedure in a regression model (Hayes and Preacher, 2014). The mediation analyses yielded a 95% confidence interval of the mediating effect using the nonparametric bootstrapping method with 5,000 resamples (Hayes and Preacher, 2014). All statistical analyses in the present study were performed using IBM SPSS Statistics for Windows Version 24.0 (IBM Corporation, Armonk, NY, USA), and statistical significance was considered at  $P = 0.05$ .

## 3. Results

### 3.1. Socioeconomic and health-related characteristics of the sample

Among 7,082 workers aged 19 years or above, 258 (3.6%) had

moderate to severe depressive symptoms (i.e., PHQ-9 score  $\geq 10$ ), 917 (12.9%) had mild depressive symptoms (i.e.,  $5 \leq$  PHQ-9 score  $\leq 9$ ), and 263 (3.7%) experienced suicidal ideation during the two weeks prior to the assessment. Between those with moderate to severe depression, mild depression, and no significant symptoms, there were significant differences in all socioeconomic and health-related variables except education level, residential region, and physical activity (Table 1). The descriptive statistics of all socio-economic and health-related variables across the categories of working hours were presented in Table S2.

### 3.2. Association of working hours with depressive symptoms and suicidal ideation

In the main analysis, individuals working  $\geq 69$  h/week were more likely to have moderate to severe (odds ratio [OR] = 2.05, 95% confidence interval [CI] = 1.22–3.42) and mild depressive symptoms (OR = 1.52, 95% CI = 1.12–2.06) compared to those working 40 hours/week (the comparison group), as shown in Table 2. Those working 53–68 h/week were more likely to have moderate to severe (OR = 1.69, 95% CI = 1.12–2.55) and mild depressive symptoms (OR = 1.34, 95% CI = 1.06–1.68) than those working 40 h/week. For suicidal ideation, working  $\geq 69$  h/week was associated with increased odds (OR = 1.93, 95% CI = 1.22–3.06), while working 35–39 h/week was associated with lower odds (OR = 0.55, 95% CI = 0.33–0.93) compared to those working 40 h/week (Table 2).

For additional analysis, we observed that working longer than 40 h/week was associated with increased odds for higher stress levels (compared to low stress levels) in a dose-response manner compared to working 40 h/week (Table S3). Working longer than 68 h/week was associated with increased odds for poor SRH (compared to good SRH) compared to working 40 h/week (Table S3).

We also performed the same analysis using the 3-level categorical variable of working hours. Working  $\geq 53$  h/week was associated with increased odds compared to working 35–40 h/week, whereas working 41–52 h/week was not (Table S4). Table S4 provides a detailed description of the results.

### 3.3. Gender-stratified association of working hours with depressive symptoms

In the gender-stratified analysis, women working  $\geq 53$  h/week were more likely to have moderate to severe (OR = 1.69, 95% CI = 1.07–2.68) or mild depressive symptoms (OR = 1.35, 95% CI = 1.02–1.78) compared to those working 35–40 h/week, while longer working hours (i.e., 41–52 or  $\geq 53$  h/week) was not associated with increased odds of depressive symptoms in men (Table 3). For suicidal ideation, longer working hours did not increase odds in both women and men (Table 3).

### 3.4. Association of working hours with depressive symptoms according to income level

In the subgroup analysis, working  $\geq 53$  h/week was associated with increased odds for moderate to severe depressive symptoms compared to working 35–40 h/week both in low (OR = 2.18, 95% CI = 1.27–3.76) and high-income groups (OR = 1.61, 95% CI = 1.03–2.53), which was higher in individuals with low income compared to those with high income (Table 3). For suicidal ideation, working  $\geq 53$  h/week was associated with increased odds only in the low-income group (OR = 1.67, 95% CI = 1.00–2.77), and not in the high-income group (Table 3).

### 3.5. Association of working hours with depressive symptoms according to job status

Working  $\geq 53$  h/week was associated with increased odds for moderate to severe depressive symptoms in non-standard (OR = 1.82, 95% CI = 1.06–3.12) and standard wage workers (OR = 3.01, 95% CI =

**Table 1**  
Socio-economic and health-related characteristics of the sample (n=7,082).

Characteristics	Depression (moderate to severe, n=258)		Mild depression (n=917)		None (n=5,907)		x <sup>2</sup>	P-value
	N	%	N	%	N	%		
Gender								
Male	102	39.5	427	46.6	3575	60.5	100.711	<0.001
Female	156	60.5	490	53.4	2332	39.5		
Age								
19–29 years	54	20.9	161	17.6	523	8.9	120.672	<0.001
30–39 years	75	29.1	218	23.8	1327	22.5		
40–49 years	46	17.8	220	24.0	1559	26.4		
50–59 years	39	15.1	197	21.5	1453	24.6		
60+ years	44	17.1	121	13.2	1045	17.7		
Education level								
Elementary school graduation or below	39	15.1	102	11.1	629	10.6	5.979	0.426
Middle school graduation	23	8.9	86	9.4	555	9.4		
High school graduation	87	33.7	315	34.4	1980	33.5		
College degree or above	109	42.2	414	45.1	2743	46.4		
Household income								
Less than Q1	39	15.1	72	7.9	370	6.3	64.002	<0.001
Q1–Q2	75	29.1	242	26.4	1309	22.2		
Q2–Q3	87	33.7	300	32.7	1948	33.0		
More than Q3	57	22.1	303	33.0	2280	38.6		
Marital status								
Widowed/Divorced/Separated	31	12.0	88	9.6	419	7.1	129.225	<0.001
Never married	78	30.2	243	26.5	899	15.2		
Married	149	57.8	586	63.9	4589	77.7		
Residential region								
Urban	208	80.6	752	82.0	4841	82.0	0.303	0.859
Rural	50	19.4	165	18.0	1066	18.0		
Working hours								
69 hours or above	32	12.4	85	9.3	455	7.7	20.322	0.009
53–68 hours	68	26.4	205	22.4	1215	20.6		
41–52 hours	82	31.8	323	35.2	2126	36.0		
40 hours	47	18.2	188	20.5	1378	23.3		
35–39 hours	29	11.2	116	12.6	733	12.4		
Job status								
Non-standard worker	103	39.9	306	33.4	1679	28.4	36.229	<0.001
Standard worker	71	27.5	358	39.0	2489	42.1		
Unpaid family worker	18	7.0	46	5.0	263	4.5		
Self-employed/Employer	66	25.6	207	22.6	1476	25.0		
Job type								
White-collar	95	36.8	385	42.0	2559	43.3	36.445	<0.001
Pink-collar	82	31.8	240	26.2	1188	20.1		
Blue-collar	81	31.4	292	31.8	2160	36.6		
Shift work								
Yes	62	24.0	153	16.7	800	13.5	26.895	<0.001
No	196	76.0	764	83.3	5107	86.5		
Chronic disease								
No	121	46.9	453	49.4	3184	53.9	16.758	0.033
1	76	29.5	261	28.5	1634	27.7		
2	34	13.2	126	13.7	702	11.9		
3	18	7.0	54	5.9	270	4.6		
4 or more	9	3.5	23	2.5	117	2.0		
Alcohol								
4 or more drinks/week	49	19.0	85	9.3	504	8.5	39.636	<0.001
2–3 drinks/week	46	17.8	180	19.6	1216	20.6		
2–4 drinks/month	50	19.4	251	27.4	1521	25.7		
1 drink/month	29	11.2	86	9.4	591	10.0		
< 1 drink/month	38	14.7	164	17.9	999	16.9		
Past or never	46	17.8	151	16.5	1076	18.2		
Cigarette smoking								
Current	101	39.1	278	30.3	1537	26.0	43.401	<0.001
Former	42	16.3	169	18.4	1485	25.1		
Never	115	44.6	470	51.3	2885	48.8		
Physical activity								
No	143	55.4	479	52.2	3138	53.1	0.837	0.658
Yes	115	44.6	438	47.8	2769	46.9		
BMI (kg/m <sup>2</sup> , mean ± SD)								
< 18.5 kg/m <sup>2</sup>	19	7.4	53	5.8	159	2.7	52.274	<0.001
18.5–22.9 kg/m <sup>2</sup>	113	43.8	355	38.7	2152	36.4		
23–24.9 kg/m <sup>2</sup>	52	20.2	195	21.3	1452	24.6		
25–29.9 kg/m <sup>2</sup>	60	23.3	268	29.2	1829	31.0		
≥ 30 kg/m <sup>2</sup>	14	5.4	46	5.0	315	5.3		
Perceived usual stress								
Very high	76	29.5	109	11.9	146	2.5	1087.960	<0.001
High	133	51.6	419	45.7	1160	19.6		

(continued on next page)

**Table 1** (continued)

Characteristics	Depression (moderate to severe, n=258)		Mild depression (n=917)		None (n=5,907)		x <sup>2</sup>	P-value
Low	48	18.6	372	40.6	3719	63.0		
Little	1	0.4	17	1.9	882	14.9		
Self-rated health								
Bad	116	45.0	257	28.0	599	10.1	532.218	<0.001
Neutral	119	46.1	526	57.4	3216	54.4		
Good	23	8.9	134	14.6	2092	35.4		
Suicidal ideation								
Yes	93	36.0	129	14.1	41	0.7	1179.848	<0.001
No	165	64.0	788	85.9	5866	99.3		

Note. Q1: first quartile; Q2: second quartile; Q3: third quartile; BMI: body mass index; SD: standard deviation.

**Table 2**

Association of working hours with depressive symptoms and suicidal ideation in a logistic regression analysis.

Working hours/week	Depression (moderate to severe)		Mild depression		Suicidal ideation	
	OR	95% CI	OR	95% CI	OR	95% CI
69 hours or above	<b>2.05</b>	1.22–3.42	<b>1.52</b>	1.12–2.06	<b>1.93</b>	1.22–3.06
53–68 hours	<b>1.69</b>	1.12–2.55	<b>1.34</b>	1.06–1.68	0.87	0.57–1.32
41–52 hours	1.07	0.73–1.57	1.11	0.91–1.36	1.02	0.72–1.45
35–39 hours	1.01	0.62–1.64	1.12	0.86–1.44	<b>0.55</b>	0.33–0.93
40 hours	1		1		1	

Note. OR, odds ratio; CI, confidence interval. If OR > 1, it is more likely to have depressive symptoms or suicidal ideation compared to referential variables. Significant ORs are presented in bold face.

1.56–5.79) compared to working 35–40 h/week, but not among self-employed/employer individuals (Table 3). Standard workers working ≥53 h/week were more likely to have mild depressive symptoms compared to those working 35–40 h/week (OR = 1.45, 95% CI = 1.05–2.01).

**3.6. Correlation between working hours and PHQ-9 score**

In the multiple linear regression analysis, working hours were positively correlated with PHQ-9 scores in the total sample, when adjusting for all socioeconomic and health-related variables (B coefficient = 0.015, beta coefficient = 0.059, P < 0.001, Table S5). In the subgroup analyses, working hours showed significantly positive correlations with PHQ-9 scores in both women and men and in both low- and high-income groups (Table S6). However, with regard to job status, working hours were significantly correlated with PHQ-9 scores only in standard and non-standard wage workers, but not in the self-employed/employer group (Table S6). Detailed information about each linear regression analysis is presented in Tables S7–S13.

**3.7. The mediating effects of perceived usual stress level and self-rated health on the relationship between working hours and depressive symptoms**

As a secondary analysis, we examined whether the perceived usual stress level and SRH were potential mediators in the association between long working hours and depressive symptoms. In the mediation analysis, we observed significant partial mediation pathways between working hours and the PHQ-9 scores through both the perceived usual stress level and SRH in the total sample (Table 4). There was a higher indirect/total effect ratio in the mediation pathway by perceived usual stress level (0.599) than by SRH (0.139). We confirmed the significance of the mediating effects of both perceived usual stress level and SRH by checking that the 95% CI of both indirect effects did not contain zero, as shown in Table 4.

**Table 3**

Sub-group analyses for the association of working hours with depressive symptoms and suicidal ideation.

Working hours/week	Depression (moderate to severe)		Mild depression		Suicidal ideation	
	OR	95% CI	OR	95% CI	OR	95% CI
<b>Male (n = 4,104)</b>						
53 hours or above	1.59	0.96–2.63	1.28	0.98–1.66	1.35	0.80–2.27
41–52 hours	0.75	0.43–1.30	0.92	0.71–1.19	1.30	0.79–2.15
35–40 hours	1		1		1	
<b>Female (n = 2,978)</b>						
53 hours or above	<b>1.69</b>	1.07–2.68	<b>1.35</b>	1.02–1.78	1.44	0.93–2.25
41–52 hours	1.32	0.88–1.98	1.23	0.97–1.55	1.20	0.79–1.81
35–40 hours	1		1		1	
<b>Low income (n = 2,103)</b>						
53 hours or above	<b>2.18</b>	1.27–3.76	1.29	0.93–1.77	<b>1.67</b>	1.00–2.77
41–52 hours	1.29	0.74–2.24	0.97	0.71–1.33	1.23	0.74–2.07
35–40 hours	1		1		1	
<b>High income (n = 4,919)</b>						
53 hours or above	<b>1.61</b>	1.03–2.53	<b>1.34</b>	1.06–1.69	1.20	0.76–1.90
41–52 hours	0.93	0.62–1.41	1.13	0.91–1.39	1.22	0.82–1.82
35–40 hours	1		1		1	
<b>Non-standard workers (n = 2,088)</b>						
53 hours or above	<b>1.82</b>	1.06–3.12	1.32	0.94–1.84	1.13	0.65–1.96
41–52 hours	1.16	0.70–1.92	1.14	0.85–1.53	1.13	0.70–1.83
35–40 hours	1		1		1	
<b>Standard workers (n = 2,918)</b>						
53 hours or above	<b>3.01</b>	1.56–5.79	<b>1.45</b>	1.05–2.01	0.95	0.47–1.94
41–52 hours	1.27	0.71–2.29	1.04	0.81–1.35	1.18	0.69–2.00
35–40 hours	1		1		1	
<b>Self-employed/ Employer (n = 1,749)</b>						
53 hours or above	0.69	0.36–1.32	1.22	0.82–1.82	2.12	1.00–4.53
41–52 hours	0.57	0.27–1.19	0.93	0.60–1.45	1.27	0.54–2.99
35–40 hours	1		1		1	

Note. OR, odds ratio; CI, confidence interval. If OR > 1, it is more likely to have depressive symptoms or suicidal ideation compared to referential variables. Significant ORs are presented in bold face.

**Table 4**

Association between working hours and PHQ-9 score mediated by perceived usual stress or self-rated health levels.

IV	M	DV	IV on M		M on DV		IV on DV		Total effect		Mediating effect of M			
			Effect	p	Effect	p	Effect	p	Effect	p	Indirect effect	SE	LCL	UCL
Working hours	Stress	PHQ-9 score	0.0058	<0.0001	1.6979	<0.0001	0.0066	0.0195	0.0164	<0.0001	0.0098	0.0014	0.0072	0.0126
	SRH		-0.0018	0.005	-1.2570	<0.0001	0.0141	<0.0001	0.0164	<0.0001	0.0023	0.0009	0.0006	0.0040

Note. All estimated effect values, p-values, standard errors, and confidence intervals were obtained from the mediation analysis by Hayes and Preacher (2014). DV, dependent variable; M, mediator; IV, independent variable; SE, boot-strapped standard error; LCL, 95% lower confidence limit; UCL, 95% upper confidence limit.

### 3.8. Secondary sub-group analysis: association of working hours with depressive symptoms according to shift work, job type, and age

We performed secondary sub-group analysis to determine whether shift work, job type, and age have potentially moderating effects on the association between long working hours and depressive symptoms. In the secondary sub-group analysis, we found that the associations between long working hours and moderate to severe depression were only significant among non-shift workers, white-collar workers, and those aged 19–49 years. However, there were no significant associations in shift workers, pink- and blue-collar workers, and those aged 50 years or above. Table S14 presents detailed results from the secondary analysis.

## 4. Discussion

By investigating a nationally representative sample of working adults, the present research clearly demonstrated that long working hours are associated with depressive symptoms. Working more than 68 h/week was related to a 2.05-fold and working more than 53 h/week (the upper limit of legally permissible working hours) was related to a 1.69-fold risk for moderate to severe depression. Moreover, working long hours showed a linear dose-response relationship with higher levels of stress, which is widely known to be associated with depression (Hammen, 2005). Meanwhile, long working hours at the extreme upper end (i.e., longer than 68 h/week) predicted poorer self-rated health, even after controlling for other health-related covariates. Moreover, mediational analysis revealed that both perceived stress and self-rated health partially explained the adverse effect of long working hours on depressive symptoms. Although the mediation analysis is based on correlational relationships, the present finding suggests the important role of the subjective experience of stress and illness due to long working hours. This research is among the small number of studies identifying the relevant mediators in this relation, offering insight into the underlying mechanism of the link.

Koreans work long hours. Despite the government's implementation of a maximum 52-hour workweek rule, Koreans work the second-longest after Mexicans among the member states of the OECD (OECD, 2020). According to the latest analysis, Koreans put in 1,993 hours of work a year, which is 259 hours longer than the OECD average of 1,734 hours. Moreover, prior research has shown that long working hours have a particularly damaging effect on mental health in Asian countries compared to European or North American nations (Virtanen et al., 2018). Overwork-related suicide, *Karojisatsu*, a growing problem in Japan, is a demonstrative example of the detrimental impact of long working hours on mental health (Amagasa et al., 2005). Thus, investigating the impact of working hours on mental well-being in Korea, a country with one of the longest working hours worldwide, would improve our understanding of the risk of long working hours.

A noteworthy finding of the present study is that not all subgroups of the population are equally vulnerable to the negative impact of long working hours on mental health. Specifically, we focused on three important demographic and socioeconomic factors: gender, income, and job status. First, women were more affected by long working hours than men. Working for longer than 53 h/week predicted moderate to severe

and mild depression in females but not in males. This is consistent with a recent analysis of Japanese working adults, which found that while the length of overtime work was negatively associated with vigor among females, a positive association between length of overtime and vigor was found among males (Amagasa and Nakayama, 2013). A possible reason may be that working women undertake much of the housework and childrearing obligations and, therefore, face the double burden of long working hours (Qian and Sayer, 2016). The presence of children in the home, in particular, may be a crucial factor that could account for the especially detrimental impact of working hours on women's mental health. Future research should examine the role of having children at home, as well as other variables that are related to female workers such as job autonomy or the demands of emotional labor (Han et al., 2018b; Hochschild, 2012).

In fact, the average amount of time spent by Korean men on housework per day has been clocked at merely 45 minutes, the second-lowest among OECD countries (OECD, 2020), compared to 227 minutes for Korean women. Thus, the negative work-family spillover effect will be larger for women with long working hours compared to men (Shimada et al., 2010), which in turn deteriorates women's mental health.

The second group expected to be particularly disadvantaged in terms of the negative consequences of long working hours is adults in low-income brackets. In general, not only did the low-income group (50.87 h/week) work longer than the high-income group (48.05 h/week), but long working hours also took a greater toll on the mental health for the low-income group than the high-income group. The odds ratio for moderate to severe depression when working more than 53 h/week among the low-income group (OR = 2.18) was 70% higher than that of the high-income group (OR = 1.61). Moreover, working more than 53 h/week was associated with suicidal ideation among the low-income group, but not among the high-income group. This suggests that there is yet another income inequality in terms of the adverse effects of long working hours on mental health. Longer working hours mean less time for labor in other domains of life, most prominently housework, and level of income determines the amount of resources, including domestic labor that one can afford (De Ruijter et al., 2005). Thus, higher income allows households to outsource domestic labor (Schneider and Hastings, 2017), which in turn reduces the burden stemming from long hours at work, particularly for women (Hochschild and Machung, 2012; Lundberg and Hellström, 2002).

Third, the stratified analysis by job status (standard, non-standard, self-employed/employer) revealed that standard and non-standard workers were more affected by long working hours (53 h/week or above) than self-employed/employer workers. Even though self-employed South Korean adults in the present dataset worked significantly longer (54.2 h/week) than those with other job statuses (standard: 46.1 h/week, non-standard: 47.7 h/week), long working hours for the self-employed/employer did not increase the probability of being depressed. One of the distinct characteristics distinguishing self-employed/employer workers from other workers is the degree of autonomy they enjoy at work. Self-employed workers have been found to have higher job satisfaction (Blanchflower, 2000). In a multinational study of 23 countries, self-employed individuals across all cultures had higher job satisfaction than employed individuals, and the primary

cause was greater autonomy at work (Benz and Frey, 2008). Even though self-employed South Korean adults are more stressed due to long working hours, their greater freedom and independence may have buffered them against depression.

Despite the merits of the present research, some limitations remain. First, the cross-sectional design of the study limits the causal interpretation of the findings. Although unlikely, considering that depression is associated with workplace absenteeism (Bhui et al., 2012), the causal direction from depression to working hours cannot be ruled out entirely from the present study. A longitudinal follow-up study could provide definitive conclusions regarding causality. Second, there may be additional mediators other than perceived stress or self-rated health that may underlie the connection between long working hours and mental health. The fact that self-employed people were more stressed and yet not affected by long working hours suggests that there may be other critical mechanisms, such as job autonomy (e.g., Yoon et al., 2018) that underlie the link between long working hours and depression. It is possible that individuals feel less autonomy with an increase in working hours. As the additional sub-group analysis indicates, there were nuanced relationships between working hours and mental health depending on shift work, job type, and age. Future studies should also focus on the potential role of these factors. Finally, since the present study employed a measurement that did not take into account off-duty hours from holidays or sick leave, these potentially related variables could not be considered in the analysis.

Importantly, this study has significant policy implications. First, the present study clearly demonstrates that working longer than the legal limit of 52 h/week (8 h/day legal working hours plus legal overtime working hours of 12 h/week) puts the workers at greater risk for depression. The Korean Labor Act sets 40 h/week (or 8 h/day) as legal working hours. Overtime work is possible up to 12 h/week, with the consent of the employee. However, because overtime up to 16 hours on weekends or holidays has not been recognized as illegal, as many as 8.1% of South Korean workers worked longer than 69 h/week, and had a greater likelihood of experiencing depression. Second, the more vulnerable groups, namely, females, low-income workers, and non-self-employed workers, would benefit from additional support to counteract the negative consequences of long working hours. For instance, workplaces can ensure that these groups receive social support, which is found to effectively moderate the negative effects of long working hours (Yoon et al., 2018) and job stress (Sanne et al., 2005). Moreover, policy makers and decision makers at the workplace should allow workers to have more autonomy, as it not only buffers against depression but also fulfills basic psychological needs that are crucial for living a quality life (Ryan and Deci, 2017).

#### Declaration of Competing Interest

The authors have no potential or actual conflicts of interest.

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#### Contributors

E. Choi prepared the first draft of the manuscript. E. Choi and K.-M. Han managed the literature search and performed the statistical analyses. E. Choi, K.-M. Han, H.-G. Jeong, M.-S. Lee, Y.-H. Ko, C. Han, B.-J. Ham, and J. Chang contributed to the data analysis and interpretation.

K.-M. Han conceived and designed the study and wrote the protocol as a corresponding author. All authors contributed significantly to this work and have approved the final manuscript.

#### Supplementary materials

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