

# Parental long working hours and adult children's depression in South Korea: a cross-sectional study

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## Research article

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# Abstract

**Background:** This study investigated the association between parental long working hours and the depression of adult children living with them in South Korea.

**Methods:** Data from two years of the Korean National Health and Nutrition Examination Survey (KNHANES) in 2014 and 2016 were analyzed using a cross-sectional study. Study samples included 1334 adult children aged  $\geq 19$  and 2486 parents (1483 mothers and 1003 fathers). Depression was assessed using the Patient Health Questionnaire-9 (PHQ-9). Logistic regression analyses were performed to determine the association between parental long working hours and their adult children's depression.

**Results:** Odds ratio (OR) of adult children's depression for maternal working  $> 60$  hours/week was 4.88 (95% confidential interval (CI): 1.95 – 12.2) when maternal working  $\leq 40$  hours/week was considered as a reference in the crude model. After considering parental and adult children's socio-demographic characteristics and occupational characteristics, and parental depression, OR of adult children's depression for maternal working was found to be 10.2 (95% CI: 2.47 – 42.0). The association between paternal long working hours and adult children's depression was not statistically significant.

**Conclusions:** Mothers' long working hours were associated with the greater risk of their adult children's depression in South Korea. Comprehending aging mothers' weekly working hours is an important factor when developing strategies for addressing adult children's depression using family-based interventions.

## Introduction

Major depressive disorder (MDD) is a psychologically common disorder and expected to be the second leading cause of disability by 2020 [1]. Not only does MDD result in a low quality of life for individuals and their families, increase high suicidal risk, and lead to worse outcomes for other health problems [2], it also burdens patients and society with huge financial costs [3]. However, individuals with MDD are seriously undertreated due to lack of awareness of symptoms, reluctance to see a doctor, and noncompliance with medication [4]. Lifetime prevalence of MDD in South Korea (hereafter "Korea") has been increasing gradually (4.0% in 2001, 5.6% in 2006, and 6.7% in 2011), and Korean public health institutions have been attempting to focus on mental disorders, especially MDD, because Korea has one of the highest rate of suicides among the Organization for Economic Cooperation and Development (OECD) countries [5].

Numerous parental characteristics such as occupation, depression, educational level, income, criminality, violence, communication, and marital status contribute to children's depressive disorders [6–9]. In particular, parental occupational characteristics, such as long working hours, are highly associated with both parents' feelings of too little time with their children and actually having less time with their children [10]. Parent-child relationships and parental monitoring are associated with decreased risk of depression of adolescents, meaning that frequent parent-child contacts has protective effects on adolescents' psychosocial status [11, 12]. Other parental occupational characteristics such as shift work are related to parent-child relationships and home environment [8].

The parent-child relationship is an important family interaction that influences children's overall well-being [13]. As parents become older and have health problems, the overall support they receive, which is often provided by adult children, is necessary to maintain their function [14]. However, the support provided by adults for elderly parents can differ depending on variable factors. Older parents and adult children's geographic proximity is an important factor for their relationship. Co-residence with adult children and living close to adult children may contribute to positive effects on older parents' psychological status [15]. Additionally, attachment representations have an impact on the quality of care that adult children provide for their older parents [16].

Overtime work and middle-aged women's labor participation have been important social topics in Korea. Koreans worked 2,124 hours per year in 2014, which is the second longest hours among OECD countries [17]. The employment rate of Korean women aged 50 to 54 increased from 55.3% in 2004 to 61.2% in 2011, and the employment rate of Korean men aged 50 to 54 increased from 87.4% in 2004 to 88.2% in 2011. However, the employment rate of young adults aged 15 to 29 decreased from 45.1% in 2004 to 40.5% in 2011. Korean middle-aged mothers, especially those who have lower educational level and are living with unemployed adult children, are more likely to become involved in labor force participation [18]. Additionally, the extended education length of adult children with high enrollment of college increases parents' money investments in children and maternal entry into the labor market [18, 19].

A considerable number of studies have described the relationships between parental occupational characteristics and the mental health of young children or adolescents [6–8, 20, 21]. Korean middle-aged mothers' re-entry into the labor market is one of the important issues nowadays [18]. However, no studies have researched direct associations between old mothers' and fathers' long working hours and the depression of adult children living with them in Korea. Therefore, the present study aimed to examine the association between parents' weekly long working hours and the depression of adult children living with them, which were analyzed for mothers and fathers, respectively.

## Methods

### Study populations

The Korean National Health and Nutrition Examination Survey (KNHANES) has been implemented regularly by the Korea Centers for Disease Control and Prevention (KCDC) since 1998. The KNHANES is a nationwide cross-sectional survey including 10,000 non-institutionalized civilians aged one year and above and composed of a health interview, health examination, and nutrition survey [22]. The sampling units were gathered by a multi-stage clustered probability design, while selected primary sampling units were divided into segments based on sex, age, and population ratio. Finally, 20 households were systematically extracted per each area [20]. The KNHANES used sample weights allocated to participants to calculate all survey statistics. The sample weights were calculated by the complex survey design, survey non-response, and post-stratification to represent all Korean populations.

This study only used health interview and health examination information; both the health interview and health examination were performed by trained medical staff members and interviewers at a mobile examination center. The study included the data for adult children aged 19 or older and their parents living in the same house in 2014 and 2016 because Patient Health Questionnaire (PHQ-9), which can be used to determine MDD, was only used as a screening tool for depression in 2014 and 2016 and particularly administered to adults aged 19 or older. Apart from 2014 and 2016 of the KNHANES when PHQ-9 was used, the other surveys used only one simple questionnaire. The final number of study participants eligible for this study were 1334 adult children aged 19 or older and 2486 of their parents (1483 mothers and 1003 fathers). The Institutional Review Board of Kangbuk Samsung Hospital approved this study (IRB No. 2019-07-032).

## Occupational Characteristics

Occupational variables of both adult children and their parents were included in this study. This study only included the current working status of parents to exclude the influence of unemployment. Jobs were classified into three groups, namely, manual workers (skilled agricultural, forestry, and fishery workers; craft workers; equipment, machine operating, and assembling workers; elementary workers), service/sales workers, and non-manual workers (managers, professionals and related workers, clerks). Work schedule was classified into two categories, namely, daytime work from 6 am to 6 pm and non-daytime referring to all other times.

In terms of the first clause of Article 50 (Work Hours) of the Korean Labor Standards Act, weekly working hours shall not exceed 40 hours except hours of recess. In addition, according to the second clause of Article 51 (Flexible Work Hours System), working hours in any particular week or in any particular day shall not exceed 52 or 12 hours, respectively. Therefore, the sum of total weekly working hours is up to 52 hours under the Korean labor law. Additionally, according to Korean Enforcement Decree of the Industrial Accident Compensation Insurance Act and Public Notice of Korean Ministry of Employment and Labor, when the average of weekly working hours during the past 12 weeks immediately before an event of disease exceeds 60 hours or 52 hours including aggravated events of overwork, cardiovascular and cerebrovascular diseases are approved as occupational diseases [17]. Therefore, study participants were divided into the following groups by weekly working hours: 40 or less hours, 41–52 hours, 53–60 hours, and over 60 hours.

## Patient Health Questionnaire-9 (phq-9)

The Patient Health Questionnaire-9 (PHQ-9) consisting of nine questions, is a self-report measure, based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria of MDD [23]. Both parents and adult children were asked to rate the nine items on a scale of 0 to 3 (0 = not at all, 1 = several days, 2 = more than half of the days, and 3 = nearly every day) over the past two weeks [23]. The total score of PHQ – 9 could range from 0 to 27 with PHQ – 9 scores of 5, 10, 15, and 20 being thresholds

for mild, moderate, moderately severe, and severe depression, respectively [24]. A cut-off value of more than or equal to 10 was chosen as this study cut-off score, which has been recommended for determining MDD in a meta-analysis [23].

## Socio-demographic Characteristics

In this study, age, sex, household economic status, current smoking status, current alcohol use, physical activity, stress, and BMI category of adult children and age, marital status, and educational level of parents were included as socio-demographic variables. Age groups consisted of adult children, their mother, and their father. Household economic status was divided into following two groups based on equivalent income: 1st quartile (the lowest 25%) and others (2nd, 3rd, and 4th quartiles). Educational levels of adult children and their parents were classified as high school or below and college or above. Adult children who responded they were currently smoking were categorized as current smoking status. Adult children who responded that they drank alcohol at least once during preceding year were categorized as current alcohol use. Physical activity of adult children, based on the Global Physical Activity Questionnaire, was classified into the following two groups: those who participated in moderate-intensity physical activity for at least 150 minutes a week, vigorous-intensity physical activity for at least 75 minutes a week, or an equal sum of moderate- and vigorous-intensity physical activity (1 minute of vigorous-intensity = 2 minutes of moderate-intensity) were defined as engaging in physical activity, and those who did not were defined as not engaging in physical activity. Adult children's stress was categorized by grouping "excessive," "much," and "often" into "Yes" and "rarely" into "No." Body mass index (BMI) of adult children was classified into following groups: normal weight ( $\geq 18.5 \text{ kg/m}^2$  and  $< 25 \text{ kg/m}^2$ ), low weight ( $< 18.5 \text{ kg/m}^2$ ), overweight ( $\geq 25 \text{ kg/m}^2$  and  $< 30 \text{ kg/m}^2$ ), and obesity ( $\geq 30 \text{ kg/m}^2$ ).

## Statistical analysis

IBM SPSS statistics for Windows 24.0 (IBM Corp., Armonk, NY, USA, released 2016) was used for all statistical analyses in this study. A complex sample design was performed to analyze all the data from the KNHANES. The provided survey sample weights were applied to represent the non-institutionalized civilian Korean population. The data were shown as mean  $\pm$  standard error (SE) for continuous factors and percentage (SE) for categorical factors. The chi-square test was performed to evaluate statistical differences between the depression of adult children and socio-demographic and occupational characteristics of adult children and their mothers and fathers, respectively. A general linear model was used to compare between depression and the age of adult children, maternal age, and paternal age. Univariate logistic regression analyses were used to examine statistical association between depression of adult children and weekly working hours of their mothers and fathers. Multivariate logistic regression analyses were performed after adjusting for maternal and paternal characteristics (age, marital status, household economic status, educational level, job classification, work schedule, and depression) and adult children's characteristics (age, sex, current smoking status, current alcohol use, physical activity, educational level, stress, BMI category, employment status, job classification, work schedule, weekly

working hours). Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated in two models. Values of  $p < 0.05$  were considered to be statistically significant.

## **Results**

Of 1334 adult children aged 19 or older and 1483 mothers and 1003 fathers were analyzed, respectively. The associations between depression of adult children and socio-demographic and occupational characteristics of adult children are presented in Table 1. Adult children who had depression were significantly more likely to be women, stressful, have the lowest quartile of household economic status, and unemployed compared with non-depressed adult children. Adult children's depression was significantly associated with their BMI category.

Table 1

General characteristics and occupational status of adult children by their depression (N = 1334).

Variables	Adult children's depression		P-value		
	Yes (N = 88)	No (N = 1246)			
	Mean (SE)	% (SE)	Mean (SE)	% (SE)	
Age	28.54 (0.88)		27.59 (0.29)		0.303
Mothers' age	54.98 (1.04)		54.72 (0.29)		0.81
Fathers' age	58.73 (1.47)		57.78 (0.38)		0.518
Sex (women)		61.4 (6.1)		40.1 (1.5)	0.001
Household economic status (1st quartile)		21.6 (5.7)		8.0 (1.1)	0.000
Current smoking (yes)		35.7 (6.0)		24.8 (1.6)	0.050
Current alcohol use (yes)		84.3 (4.0)		88.2 (1.1)	0.297
Physical activity (yes)		47.3 (2.4)		52.7 (0.7)	0.339
Stress (yes)		99.1 (0.9)		88.6 (1.1)	0.001
Educational level (college or above)		40.1 (5.8)		43.1 (1.8)	0.623
Employment status (no)		54.7 (6.6)		37.9 (1.8)	0.013
Work schedule (non-daytime)		20.4 (5.7)		28.0 (1.6)	0.251
BMI category (kg/m <sup>2</sup> )					
Low weight (< 18.5)		20.1 (5.4)		8.7 (0.9)	0.002
Normal (18.5–24.9)		47.6 (6.2)		65.7 (1.6)	
Overweight (25.0-29.9)		20.6 (5.7)		20.7 (1.4)	

Variables	Adult children's depression		P-value
Obesity ( $\geq 30.0$ )	11.7 (4.2)	4.9 (0.7)	
Job classification <sup>a</sup>			
Manual	20.3 (7.6)	25.0 (1.9)	0.696
Service/sales	32.6 (8.7)	25.9 (1.9)	
Non-manual	47.1 (9.8)	49.1 (2.1)	
Working time (hours/week)			
$\leq 40$	53.5 (7.3)	56.6 (1.7)	0.573
41–52	28.2 (6.5)	25.8 (1.6)	
53–60	7.5 (3.8)	11.2 (1.1)	
> 60	10.9 (4.6)	6.5 (0.8)	
<p>Note. Data are presented as mean (SE) or percentage (SE), SE = standard error, BMI = body mass index.  <sup>a</sup> Job classification: manual workers (skilled agricultural, forestry, and fishery workers; craft workers; equipment, machine operating, and assembling workers; elementary workers), service/sales workers, and non-manual workers (managers, professionals and related workers, clerks).</p>			

Table 2 presents the marital status, educational level, depression, and occupational variables of mothers and fathers according to the depression of adult children, respectively. Mothers' educational level, job classification and weekly working hours, and fathers' marital status, educational level, and depression were significantly associated with the depression of adult children. Both mothers and fathers having adult children with depression had significantly higher portion of educational status of high school or below. Paternal groups with adult children with depression were more likely to be depressed and separated or divorced in their marriage.

Table 2

Parental marital status, educational level, and occupational status by adult children's depression (N = 1334).

Variables	Adult children's depression		P-value
	Yes (N = 88), % (SE)	No (N = 1246), % (SE)	
Mothers			
Marital status (separated or divorced)	15.0 (5.2)	7.9 (1.2)	0.078
Educational level (high school or below)	94.1 (2.9)	78.0 (1.8)	0.002
Depression (yes)	8.8 (3.6)	5.4 (0.8)	0.233
Employment state (no)	48.3 (7.2)	44.0 (2.1)	0.573
Work schedule (non-daytime)	12.7 (6.3)	17.7 (1.8)	0.511
Job classification <sup>a</sup>			0.043
Manual	38.1 (8.8)	34.4 (2.6)	
Service/sales	53.6 (9.3)	36.7 (2.6)	
Non-manual	8.3 (5.4)	28.9 (2.5)	
Working time (hours/week)			0.003
≤ 40	34.9 (8.0)	58.8 (2.7)	
41–52	21.0 (6.7)	21.4 (2.2)	
53–60	14.4 (6.6)	9.6 (1.4)	
> 60	29.6 (8.1)	10.2 (1.5)	
Fathers			
Marital status (separated or divorced)	9.3 (4.9)	2.9 (0.8)	0.042
Educational level (high school or below)	87.2 (5.4)	62.6 (2.6)	0.002
Depression (yes)	7.1 (4.2)	1.1 (0.4)	0.003
Employment state (no)	25.6 (9.5)	18.7 (1.8)	0.425
Work schedule (non-daytime)	19.4 (8.6)	17.4 (2.4)	0.797
Job classification <sup>a</sup>			0.148
Manual	64.1 (9.7)	51.4 (3.2)	
Service/sales	17.6 (7.4)	11.5 (1.7)	

Variables	Adult children's depression		P-value
	Yes (N = 88), % (SE)	No (N = 1246), % (SE)	
Non-manual	18.3 (7.8)	37.1 (2.9)	
Working time (hours/week)			0.215
≤ 40	43.9 (9.9)	44.5 (2.6)	
41–52	16.6 (8.1)	24.1 (2.2)	
53–60	9.4 (4.1)	15.2 (2.0)	
> 60	30.2 (9.4)	16.1 (1.9)	
<p>Note. Data are presented as percentage (SE), SE = standard error; BMI = body mass index.  <sup>a</sup> Job classification: manual workers (skilled agricultural, forestry, and fishery workers; craft workers; equipment, machine operating, and assembling workers; elementary workers), service/sales workers, and non-manual workers (managers, professionals and related workers, clerks).</p>			

Table 3 presents the relationship between weekly working hours of parents and depression of their adult children. Mothers and fathers working  $\leq 40$  hours a week were considered as a reference group in all models, respectively. ORs (95% CI) of depressive adult children for working  $> 60$  hours a week were 4.88 (1.95–12.2) in mother and 1.90 (0.72–4.97) in father, respectively. In Model 1, after adjusting for maternal and paternal age, marital status, household economic status, educational level, job classification, non-daytime work, and depression, respectively, ORs (95% CI) were 5.05 (1.81–14.1) in mother and 1.61 (0.56–4.64) in father. In Model 2, after adjusting for confounders of Model 1 plus adult children's age, sex, current smoking state, current alcohol use, physical activity, educational level, stress, BMI category, employment status, job classification, non-daytime work, and weekly working hours, ORs (95% CI) were 10.2 (2.47–42.0) in mother and 4.34 (0.98–19.2) in father, respectively. Additionally, mothers' working for 53–60 hours a week was statistically significant only in Model 2, and its OR (95% CI) was 6.20 (1.58–24.2). As a result, working more than 60 hours only in mothers was significantly associated with depression of adult children in all models. In addition, significantly positive linear trends of dose-response relationship were found between parental working hours per week and their children's depression status in all models of mothers and only in Model 2 of fathers (Fig. 1).

Table 3

ORs and 95% CIs of adult children's depression according to parental weekly working hours.

	Mothers			Fathers		
	Crude OR (95% CI)	Model 1 <sup>a</sup> OR (95% CI)	Model 2 <sup>b</sup> OR (95% CI)	Crude OR (95% CI)	Model 1 <sup>a</sup> OR (95% CI)	Model 2 <sup>b</sup> OR (95% CI)
Working time (hours/week)						
≤ 40	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
41–52	1.65 (0.67– 4.09)	1.83 (0.67– 4.98)	2.69 (0.50– 14.4)	0.70 (0.21– 2.28)	0.70 (0.21– 2.29)	0.32 (0.09– 1.11)
53–60	2.54 (0.82– 7.92)	2.75 (0.71– 10.6)	6.20 (1.58– 24.2)	0.63 (0.22– 1.75)	0.54 (0.18– 1.65)	1.34 (0.28– 6.42)
> 60	4.88 (1.95– 12.2)	5.05 (1.81– 14.1)	10.2 (2.47– 42.0)	1.90 (0.72– 4.97)	1.61 (0.56– 4.64)	4.34 (0.98– 19.2)
P for trend	0.001	0.002	0.001	0.364	0.687	0.035
Note. OR = odd ratio, CI = confidence interval						
<sup>a</sup> Model 1: adjusted for maternal and paternal age, marital status, household economic status, educational level, job classification, depression, and non-daytime work, respectively.						
<sup>b</sup> Model 2: adjusted for confounders of Model 1 plus adult children's age, sex, current smoking state, current alcohol use, physical activity, educational level, stress, employment status, job classification, non-daytime work, and weekly working hours.						

## Discussion

In the current study, we performed a cross-sectional analysis from 2014 and 2016 KNHANES data to determine the relationship between weekly working hours of older parents and their adult children's depression. Our findings suggested that mothers' long working hours of more than 60 hours per week compared to 40 hours or less were significantly associated with their adult children's depression with positively linear trends after controlling for confounders of parents and adult children.

As Table 1 indicates, the study results offered some key findings. First, among adult children, women were significantly more likely to have depression according to this study, which is consistent with other study findings [6, 25, 26]. In a previously summarized review study, women were found to be twice as likely to have depression than men [6]. Women's sex hormones, dual roles as worker and parent, and ruminative response style could contribute to their higher depression rate [6]. An opposite-sex twin study in the US also has reported that personality and interpersonal relationship failures become a key role in depression

for women than men [27]. Second, adult children with the lowest household economic status group were found to be more likely to have depression. Several studies have indicated that lower socioeconomic status (SES), which includes income, education, and occupation, could lead to young children's mental health problems [7, 21]. Adolescents and adults with low household income in childhoods are more likely to have depression, stress, and suicidal ideation [20, 28]. In addition, previous studies have also demonstrated that depression is related to SES, especially income [29–31] because higher income may refer to low financial stress and economic margin to deal with depression [31]. Although above previous studies have only compared associations between low household income and depression of young children or adolescents, and not adult children, older parents and their adult children also remain connected over their lifetime [32]. Further studies are needed to better identify the relationships between parental low household economic status and adult children's depression. Third, we also found that there was a significant association between stress and depression in adult children, and a review study has documented the effects of psychological stress on depression by examining brain regions, endocrine system, and immune system [33]. Fourth, the study results indicated that the employment status of adult children was significantly related to their depression. Economically inactive men have a higher risk of depression than women [34–36], and long-term unemployment is highly related to depression in comparison with short-term unemployment [37]. Finally, we found that adult children's BMI was associated with their depression, which is consistent with previous studies showing that those who are underweight and those who are severely obese are more likely to be depressed than those who are of normal weight and those who are overweight (U-shaped relationship) [38, 39]. Additionally, the treatment of obesity or depression seems to improve the other disorder and vice versa, and both disorders possibly affect each other in a bi-directional way [40, 41]. In young adults, depression could lead to obesity through physical activity decrease and emotional eating as mediators [32, 41].

As Table 2 indicates, we determined several important associations between maternal and paternal characteristics and adult children's depression. First, we found that parental educational level (high school or below) was highly related to adult children's depression. Previous studies have described that the risk of children's depression tends to decrease as parental education level increases [42], and highly educated parents tends to have children who are better educated, healthier, and better in all areas [43, 44]. Mental health problems in young children are highly related to parent educational level and income [44]. Second, our results also found that maternal job classification (manual, services/sales, and non-manual work) was related to adult children's depression. Our study result was consistent with previous research indicating that young children and adolescents with parental low occupational status have higher mental health risks [45], and parental occupation has a large influence on young children's mental health [46]. Since most studies have been on adolescents or young children, further studies investigating the influences of parental education level and parental job classification on adult children are needed. Third, this study showed that the association between paternal depression and the depression of adult children was statistically significant. Previous studies found that parents' depression is strongly associated with adolescents and young adults' depression [47–50]. Finally, in the present study, paternal marital status of separation or divorce was significantly related to the depression of adult children. A previous study has shown that the family environment including parental divorce or separation appears to demonstrate the

relationship between low family income and childhood depression as a mediator [51]. Adolescents from divorced families have a higher risk of depression [52]. Adult children going through parental divorce have lower level of SES and face problems in relationships with other people, leading to their depression [53].

The current study's main finding was that mothers working > 60 hours a week was significantly associated with the higher risk of depression of adult children in both the crude model, Model 1 and Model 2 with positive dose-response ways. Additionally, mothers working for both 51–60 hours and > 60 hours per week was statistically significant for adult children's depression status. Potential mechanisms of the association between maternal long working hours and adult children's depression are not fully comprehensible yet. Additionally, there are few studies focusing on relations between old parents' occupational status and the depression of adult children. Therefore, several explanations below can be offered about the relationship between parents and young children or adolescents, but not for adult children. The first possible explanation for the association between maternal long working hours and the risk of children's depression living with parents is that maternal long working hours could replace family interaction time together. Mothers' overtime work means the shortness of family time and meals together, which are important for family communication and attachment [8, 10, 54, 55]. Maternal part-time workers (defined working  $\leq 34$  hours/week) have lower work-family conflict for families with young children compared with maternal full-time workers [10]. The relationships between parental occupational schedules and adolescents' depression are explained by important mediators such as low quality of home environment including low parental emotional support and less times of meals together [8]. Thus, maternal long working hours could lead to young children's depression. We assume that the first mechanism of the influence of maternal long working hours on young children or adolescents could apply to adult children because a lack of parents' support during childhood is related to the higher risk of depression in adulthood [56] and older parents' and adult children's feelings might be interdependent and remain connected [57]. Another explanation for the association between mothers' long working hours and depression of children involves maternal depression. A systematic review about the association between long working hours and mental health explains that those who work long hours are more likely to have depression, sleep problem, and anxiety [58, 59]. A considerable number of studies has demonstrated that parental depression increases the risk of depression and other mental problems of adolescents and young adults [47–50]. Therefore, long working hours of mothers could increase the risk of maternal depression, and maternal depression could increase children's depression. The final possible mechanism of the influence of maternal long working hours on children's depression is mediated by marital status instability. Several studies have found that maternal weekly long working hours increase the risk of separation or divorce [17, 54, 60], and a systematic review shows that those who experience childhood parental divorce are more likely to have depression in adulthood [61]. Another systematic review also displays significant moderators such as offspring gender, offspring age at depression onset, and maternal sensitivity between parental divorce/separation and offspring (adolescents and adults) depression [62]. Therefore, maternal long working hours could have an influence on the risk of adult children's depression as mediated by parental marital dissolution.

Korean middle-aged women's employment rate increased from 2004 to 2011 compared to Korean middle-aged men [18]. As a result, long working hours of Korean mothers might have a negative impact on adult children's depression due to low family interaction time, onset of mothers' depression, and marital status instability. However, parent-child relationships have mostly focused on young children or adolescents, and not adult children, but in terms of parent-child relationships, adult children also have intimate relationships with their aging parents [63]. Therefore, the association between mothers' long working hours and adult children's depression could be explained in similar ways. Future studies focusing on the relation between parents and adult children depression are needed.

Several limitations of this study should be considered. First, this study only considered the relation between parents and their adult children aged  $\geq 19$ , not adolescents or younger children. However, this study is one of the few studies to describe the relation between old parents' long working hours and the depression of adult children. Second, even though this study considered Korean parents and adult children from the nationally representative data of KNHANES, we used a cross-sectional study. Thus, this study could not define whether old mothers' long working hours was the reason or consequence of adult children's depression. Further cohort studies investigating changes of parental weekly working hours and adult children's PHQ-9 scores are necessary to identify the association between parental long working hours and adult children's depression. Third, although the study data were analyzed by adjusting for confounding factors such as parental socio-demographic and occupational characteristics and adult children's socio-demographic and occupational characteristics, further studies controlling other considerable confounders such as attachment representations, parental chronic diseases, and parental mental disorders. Fourth, our study samples lived together in the same house. This study could not investigate a factor of geographic proximity between old parents and adult children. Finally, weekly working hours were surveyed through a self-reported questionnaire, which might be overestimated. However, PHQ-9 was evaluated using the face-to-face interview method, which helped understand the scale responses further [5].

## Conclusions

In conclusion, this study demonstrated that mothers' weekly long working hours were highly associated with the risk of adult children's depression in Korea, after adjusting for mothers' socio-demographic and occupational variables, and depression and adult children's socio-demographic and occupational variables. Additionally, because the study samples were living together, a characteristic of geographic proximity between parents and children could be excluded. These results emphasize that comprehending mothers' weekly working hours is an important factor when developing strategies for addressing adult children's depression using family-based interventions and for understanding the reason of adult children's depression. However, because the study only described the association between mothers' long working hours and their adult children's depression, long term follow-up studies of adult children's depression are needed for determining more concrete causality, considering other possible confounding factors in the future.

## Abbreviations

KNHANES:Korean National Health and Nutrition Examination Survey; PHQ-9:Patient Health Questionnaire-9; MDD:Major depressive disorder; OECD:Organization for Economic Cooperation and Development; KCDC:Korean Centers for Disease Control and Prevention; DSM-IV:Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; BMI:Body mass index

## Declarations

### Ethics Approval And Consent To Participate

The KNHANES data are openly distributed. Therefore, this study did not collect informed consent from the participants. Their personal information was fully anonymized and deidentified prior to analysis. The Institutional Review Board of Kangbuk Samsung Hospital approved this study (IRB No. 2019-07-032).

### Consent For Publication

Not required.

### Availability Of Data And Materials

All relevant data are included in this manuscript. Raw data of KNHANES 2014 and 2016 in this study is available from <https://knhanes.cdc.go.kr/knhanes/main.do>.

### Competing interests

None declared.

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### Authors' contributions

HIK, WCL, and HCK participated in the conception and design of the study. HIK, WCL, and SYP drafted the manuscript. HIK, WCL, SYP, and HCK contributed to the revision of article. All authors read and approved the final manuscript.

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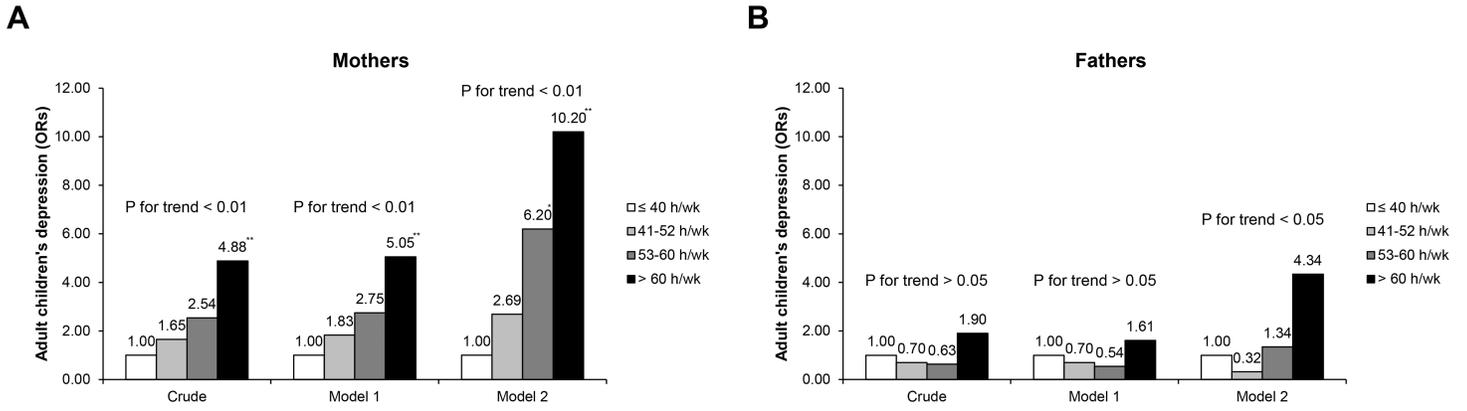
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## Figures



**Figure 1**

Odd ratios of adult children's depression according to (A) mothers' and (B) fathers' weekly working hours in the crude model, Model 1, and Model 2 (see Table 3). h/wk = hours/week, \* P-value < 0.05, \*\* P-value < 0.01.