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# Association between Long Working Hours and Depressive Disorder

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# Association between Long Working Hours and Depressive Disorder

A Master' s Thesis

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## ABSTRACT

### Association between Long Working Hours and Depressive Disorder

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**Objective:** This study examined the relationship between depressive disorder and long working hours in a rapidly developing country (Korea).

**Methods:** Data were collected from 1865 participants in 2014, through the 6<sup>th</sup> Korean National Health and Nutrition Examination Survey. After adjusting for demographic, health-related, and occupational characteristics, multivariate logistic regression models were used to estimate odds ratios and 95% confidence intervals for the relationship between depressive disorder and working hours. After adjusting for age, body mass index, educational level, marital status, sleep duration, exercise, smoking, drinking, shift work, occupational grade,

employment status, and household income.

**Results:** We found that male workers who worked  $\leq 35$ , 46-55, 56-65, or  $\geq 65$  h per week were more likely (odds ratios (95% confidence intervals): 4.45 (1.20-16.48), 3.39 (1.01-11.44), 2.21 (0.44-11.17), and 6.27 (1.53-25.34), respectively) to have depressive disorder as compared to those who worked 36-45 h per week. Among female workers, those working  $\leq 25$ , 40-55, 55-70, or  $\geq 70$  h per week were more likely (odds ratios (95% CIs): 1.65 (0.74-3.69), 0.95 (0.44-2.04), 0.74 (0.20-2.77), 7.12 (1.85-37.46) respectively) to have depressive disorder compared to those working 26-40 h per week.

**Conclusion:** The results indicate that long working hours are associated with depressive disorder among employees in Korea. Especially, the prevalence rate of depressive disorder increases rapidly when the working time is very long (male > 65hr, female > 70hr). The relationship between long hours of work and depressive disorder is more significant in men than in women.

**Keywords:** Long working hours, Depressive disorders, Cross-sectional study

## I. Introduction

Long working hours (LWH) have negative effects on the safety and health of workers and lead to lower productivity. Hence, the International Labour Organization (ILO) suggested 8 hours a day or 48 hours a week as appropriate working hours. (Gasskov),(Caruso et al., 2006)

Several studies have suggested that LWH affect worker's health status in both the short and long-term. The short-term effects of LWH vary, such as stress, physical and mental fatigue, and sleep disorder. In the long-term, LWH increase the risk of cardiovascular disorder, musculoskeletal disease, and reproductive disease. In addition, LWH are related to increase in unhealthy alcohol consumption and smoking. (Gasskov),(Caruso et al., 2006),(Johnson and Lipscomb, 2006),(Trinkoff et al., 2006)

Depressive disorder negatively affects not only workers' health and quality of life directly, but also society and corporations indirectly by lowering productivity. Hence, workers' depressive disorder leads to medical costs and indirect social costs that include loss of productivity. (Bender and Farvolden, 2008),(Stewart et al., 2003)

According to a 2015 OECD report, Korea had the highest suicide rate among member countries, while visiting rates to clinicians among patients with depressive disorder was among the lowest among OECD countries. Furthermore, the prevalence of mental illnesses including

depressive disorder among those aged 30-50 years, which comprises the main workforce, was 3 times higher than other age groups. Thus, Korean workers seem to have serious problems regarding mental health. (OECD.2015)

Socioeconomic status such as sex, age, education level, and lifestyle habits such as smoking and alcohol consumption influence depressive disorder. (Mudgal et al., 2006),(Talala et al., 2008),(Lee et al., 2008) Furthermore, a poor work environment has been directly linked to depressive disorder. In particular, having LWH is a major source of occupation stress and affects the mental and physical health of workers. (Kleppa et al., 2008)

In 2014, the annual number of work hours for Korean was 2,057 which is the third-longest hours among OECD countries. Korean workers worked 351 hours longer than the OECD average of 1706.(OECD, 2014) Moreover, this number is lower than that in the early 2000's due to the implement of 40 working hours per week in accordance with the standard law for labor. However, Korean workers still work much longer hours compared to workers in other countries.(Bae, 2013)

To date, several studies have shown an association between LWH and mental illness. However, these studies used mainly Western samples, and there is a lack of evidence from rapidly developed Asian countries such as Korea.(Shields, 1999),(Virtanen et al., 2011),(Bildt and Michélsen, 2002),(Michelsen and Bildt, 2003) Moreover, although some studies from Korea have suggested the relationship between LWH and mental illness, they did not use scientific tools for assessing depressive disorder,

such as questionnaires.(Kim et al., 2013) Therefore, our current study, which used the PHQ-9 to define depressive disorder as an adverse health effect of LWH, contributes greatly to the existing scientific evidence. Furthermore, we hope our gender-stratified analysis and comprehensive discussion could be used to develop strategies for preventing depressive disorder among workers suffering from LWH.

## II. Methods

### 1. Ethics statement

All participants provided their written informed consent and private records related to the participants' identities were anonymized prior to analysis. This survey was approved by the Institutional Review Board (IRB) of the Korea Centers for Disease Control and Prevention (IRB: 2015-01-02-6C).

The secondary use of the data was reviewed by the Institutional Review Board of the Yonsei university health system (Y-2017-0094).

## 2. Participants

This study was based on representative data from the sixth Korean National Health and Nutrition Examination Survey (KNHANES VI), conducted by the Ministry of Health and Welfare. Multistage probability sampling was carried out using stratification according to geographic location, sex, and age.

The KCDC conducted KNHANES VI from 2013 to 2015. Before 2014, the symptoms for depressive disorder were determined using three self-answered questions; In 2014, the PHQ-9 used to score the severity of depressive disorder. From 2015 on, mental health is evaluated by 10 items that respond to symptoms related to depression, stress, and suicide.

This study analyzed data from 2014, which used the PHQ-9.

In total, 7550 individuals participated in KHHANES VI, of whom 1865 workers (931 men, 932 women) were included in the current analysis.

### 3. Demographic and health-related characteristics

Demographic, health-related characteristics data such as gender, age, household income, marital status, alcohol consumption, smoking status, and exercise were acquired through interview. Household income was calculated from total family income adjusted for family size. Household incomes was categorized into low, middle-low, middle-high, and high household income group. “regular alcohol drinking” was defined as consuming  $\geq 7$  and 5 glasses of alcohol  $\geq 2$  times per week among men and women, respectively. A regular aerobic exercise was defined as doing more than 2 and half hours per week of the moderate exercise or 1 hour and 15 minutes per week spent on the high strain physical exercise.

#### 4. Depressive disorder, Occupational characteristics and Long working hours (LWH)

Depressive disorder was assessed by the self-reported PHQ-9. Presence of a depressive disorder was defined as PHQ-9 score  $\geq 10$ , in accordance with previous studies. (Martin et al., 2006)

Work schedules were categorized into regular and shift work. Occupations were categorized as office worker, service worker, or manual worker.

Male participants entered the average number of hours they work per week in 45 and female participants entered the average number of hours they work per week in 36. There was a significant difference in the distribution pattern of work hours between genders. Women worked shorter work hours a week compared to men, and many of them worked less than 35 hours a week. Therefore, the number of working hours were categorized as  $\leq 35$ , 36-45, 46-55, 56-65, and  $>65$  for men and  $\leq 25$ , 26-40, 41-55, 56-70 and  $>70$  for women.

The reference group for both genders were participants with normal work hours (36-45 and 26-40 hours/week for men and women, respectively), according to the Korea Labor Standards Act (a 40-hour workweek is standard; 12 additional hours per week are allowed with workers' agreement).

## 5. Data analysis

We used chi-squared tests and t-tests to identify differences in depressive disorder between groups (Table 1).

To examine and fit the non-linear effect of LWH on depressive disorder, the generalized additive model was used for plotting (Fig 1). The lowest level of centered mean effect for depressive disorder in the generalized additive model was 35-45 hours per week in men, and 35-40 hours per week in women. These categories of working hours were used as references to investigate the relationship between working hours and depressive disorder. Hence, to fit the model into quintiles the number of working hours per week were divided into <35, 35-45, 45-55, 55-65, and  $\geq 65$  for men, and <25, 25-40, 40-55, 55-70, and  $\geq 70$  for women (Fig1).

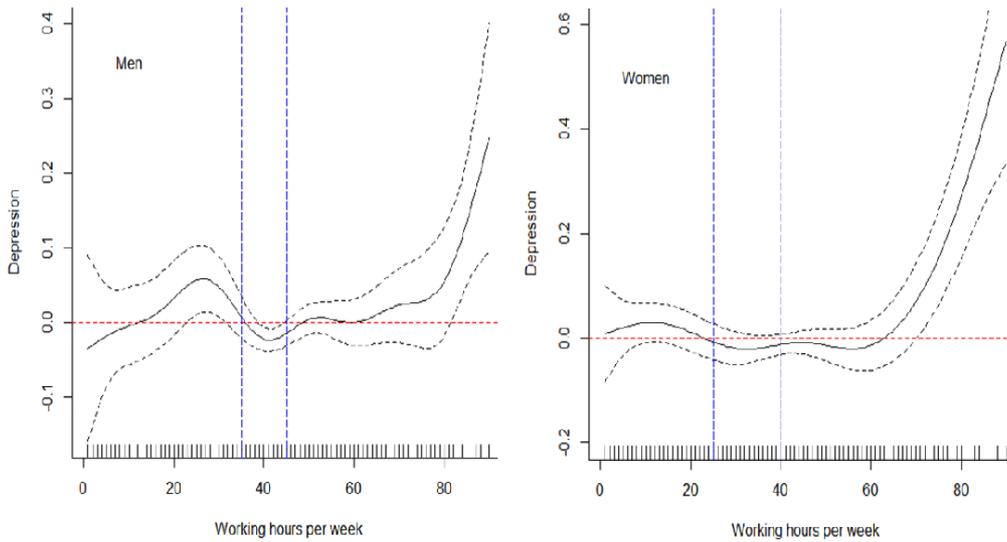
Multivariate logistic regression models were used to estimate odds ratios (ORs) and 95% confidence intervals (95% CIs) (Table 2). Two-tailed p-values less than 0.05 were considered statistically significant. All analyses were performed with SAS Version 9.3.

### III. Results

#### 1. General findings

Workers who worked long hours had significantly increased prevalence of depressive disorders compared to the reference groups for both genders (Fig 1, Table 1). We found that the associations between depressive disorders and working hours were J-shaped (Fig 1).

Figure 1. Centered mean effect for depressive disorder by working hours for week



The prevalence of depressive disorders differed significantly between genders. The prevalence of depressive disorder was higher in women (6.05%) than in men (3.44%) ( $p = 0.008$ ). Depressive disorders were significantly more prevalent in younger groups (aged 30 or younger) compared to older groups (aged 50 or older), those sleeping  $\geq 10$  h per day compared to those sleeping 6-10 h, those with low household incomes compared to high household incomes, and current smokers compared to non- or former smokers, for both genders (Table1).

Table 1. Demographic, health related and occupational characteristics of study population.

	<b>Men</b>		<b>P</b>	<b>Women</b>		<b>P</b>
	<b>(n=931)</b>			<b>(n=932)</b>		
	<b>Depressive disorder</b>			<b>Depressive disorder</b>		
	<b>PHQ-9 &lt; 10</b>	<b>PHQ-9 ≥ 10</b>		<b>PHQ-9 &lt; 10</b>	<b>PHQ-9 ≥ 10</b>	
<b>Demographic characteristics</b>						
<b>Age</b>			0.006 *			0.006 *
<30	107 (93.9)	7 (6.1)		155 (88.5)	20 (11.4)	
<40	248 (93.9)	16 (6.1)		210 (94.2)	13 (5.8)	
<50	203 (97.6)	5 (2.4)		202 (96.6)	7 (3.4)	
≥50	340 (98.6)	5 (1.5)		320 (95.0)	5 (5.0)	
<b>House income</b>			0.018			<.001 *
1 <sup>st</sup>	54 (90.0)	6 (10.0)		95 (84.8)	17 (15.2)	
2 <sup>nd</sup>	181 (95.8)	8 (4.2)		211 (96.4)	8 (3.6)	
3 <sup>rd</sup>	321 (96.4)	12 (3.6)		282 (95.6)	13 (4.4)	
4 <sup>th</sup>	342 (98.0)	7 (2.0)		295 (94.0)	19 (6.0)	

<b>Marriage status</b>			0.716			0.002 *
married and live together	220 (96.1)	9 (3.9)		571(95.8)	25 (4.2)	
Others	678 (96.6)	24 (3.4)		316 (90.8)	32 (9.2)	
<b>Education level</b>			0.547			0.417
<high school graduate	512(96.2)	20 (3.8)		606(93.5)	42 (6.5)	
≥college graduate	384 (97.0)	12 (3.0)		278(94.9)	15 (5.1)	
<b>Sleep hours</b>			<.001 *			0.022 *
≤ 5	118(92.9)	9 (7.1)		138(89.6)	16 (5.2)	
6-10	760(97.6)	4 (2.4)		722 (95.0)	38 (5.0)	
≥10	19 (97.1)	19 (17.4)		25(89.3)	3(10.7)	
<b>BMI</b>			0.556			0.291
≤ 25	512(96.2)	20 (3.8)		693(93.5)	48 (6.5)	
> 25	384(97.0)	23 (3.0)		192(95.5)	9 (4.5)	
<b>Health related factors</b>						
<b>Smoking</b>			0.025 *			<.001 *
non-smoker	384 (94.6)	22 (5.4)		44 (75.9)	14 (24.1)	
ex-smoker	291 (98.0)	6 (2.0)		45 (97.8)	1 (2.2)	

current smoker	223 (97.8)			798 (95.0)	42 (5.0)	
<b>Alcohol drinking</b>			0.563			0.190
Others	535 (96.8)	18 (3.2)		661 (94.6)	38 (5.4)	
regular alcohol drinking	363 (96.0)	15 (4.0)		266 (92.2)	19 (7.8)	
<b>Exercise</b>			0.858			0.606
regular aerobic exercises	557 (96.4)	21 (3.6)		458 (93.7)	31 (6.3)	
no-regular aerobic exercises	340 (96.6)	12 (3.4)		426 (94.5)	25 (5.5)	
<b>Occupational characteristics</b>						
<b>Working hours per week</b>						
≤ 35	159 (94.6)	9 (5.4)	0.012 *	≤ 25	227 (92.7)	18 (7.3)
36-45	348 (98.9)	4 (1.1)		26-40	341 (95.3)	17 (4.7)
46-55	229 (95.8)	10 (4.2)		41-55	236 (94.4)	14 (5.6)
56-65	94 (96.9)	3 (3.1)		56-70	68 (95.8)	3 (4.2)
>65	67 (91.8)	6 (8.2)		>70	13 (73.2)	5 (27.6)
<b>Employment status</b>			0.021 *			0.334

standard employment	677 (97.3)	19 (2.7)		524 (94.6)	30 (5.4)
non-standard	221 (94.0)	14 (6.0)		363 (93.1)	27 (6.9)
employment					
<b>Working schedule</b>			0.991		0.891
day work	734 (96.5)	27 (3.5)		736 (93.8)	48 (6.1)
nigh or shift work	164 (96.5)	6 (3.5)		151 (93.4)	9 (5.6)
<b>Occupation</b>			0.094		0.165
office worker	436 (97.8)	10 (2.2)		426 (95.5)	20 (4.5)
service worker	96 (94.1)	6 (5.9)		196 (92.5)	16 (7.5)
manual worker	366 (95.6)	17 (4.4)		265 (95.6)	21 (7.3)

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\* P values are for trend analysis by Cochran-Armitage test

## 2. Multivariate analysis of working hours and depressive disorders

Multivariate logistic regression models were conducted after controlling for confounding variables.

Model I was adjusted for age, body mass index, educational level, marital status, hours of sleep, exercise, smoking, drinking, shiftwork, occupational grade, and employment status. Among male workers, compared with the group working 35-45 h per week, the odds ratios (ORs) for depressive disorders among those working  $\leq 35$ , 45-55, 55-65, or  $\geq 65$  h were 4.45 (95% CI: 1.20-16.48), 3.39 (95% CI: 1.01-11.44) 2.21 (95% CI: 0.44-11.17), 6.27 (95% CI: 1.53-25.34), respectively. Male workers who worked overtime the most showed a significantly higher prevalence of depressive disorder (Table 2). Among female workers, compared with the group working 25-40 h, the ORs for depressive disorders among those working  $\leq 25$ , 40-55, 55-70, or  $\geq 70$  h were 1.65 (95% CI: 0.74-3.69), 0.95 (95% CI: 0.44-2.04), 0.74 (95% CI: 0.20-2.77), 7.12 (95% CI: 1.85-37.46) respectively (Table 2).

Model II was additionally adjusted for household income. Among male workers, the ORs for depressive disorders among those working  $\leq 35$ , 45-55, 55-65, or  $\geq 65$  h were 3.44 (95% CI: 0.88-13.48), 3.68 (95% CI: 1.08-12.50), 2.33 (95% CI: 0.46-11.81), 6.52 (95% CI: 1.60-26.70), respectively (Table 2). Among female workers, the ORs for depressive disorders among those working  $\leq 25$ , 40-55, 55-70, or  $\geq 70$  h were 1.41 (95% CI: 0.60-3.23), 1.02 (95% CI: 0.47-2.20), 0.83 (95% CI: 0.22-3.12), 6.98 (95% CI: 1.73-28.26) respectively (Table 2).

Table 2. Odds ratio (95% confidence intervals) of working hours on depressive disorder

		Model I*	Model II†
<b>Working hours per week</b>			
<b>Men</b>	≤ 35	4.45(1.20-16.48)	3.44(0.88-13.48)
	36-45	1	1
	46-55	3.39(1.01-11.44)	3.68(1.08-12.50)
	56-65	2.21(0.44-11.17)	2.33(0.46-11.81)
	>65	6.27(1.53-25.34)	6.52(1.60-26.70)
<b>Women</b>	≤ 25	1.65(0.74-3.69)	1.41(0.60-3.23)
	26-40	1	1
	41-55	0.95(0.44-2.04)	1.02(0.47-2.20)
	56-70	0.74(0.20-2.77)	0.83(0.22-3.12)
	>70	7.12(1.85-37.46)	6.98(1.73-28.26)

\*: adjusted for demographic characteristics(age, marriage, education level, sleep hour, BMI), health related characteristics(smoking, alcohol drinking, exercise) and occupational characteristics(employment status, working schedule, occupational grade )

†: adjusted for demographic characteristics(age, marriage, education level, sleep hour, BMI), health related characteristics(smoking, alcohol drinking, exercise) ,occupational characteristics(employment status, working schedule, occupational grade) and house income

## IV. Discussion

The present study found that employees who work long hours, regardless of gender, are more likely to suffer from a depressive disorder compared to reference groups, who work standard hours. Even after adjusting for other factors that could affect depressive disorder, LWH was identified as a substantial factor that led to depressive disorder. The correlation between LWH and depressive disorder was more significant in men. This study is the first in Korea to provide evidence of the relationship between LWH and depressive disorder using nationally representative data and validated clinical tools.

In this study, we approached working hours between the two genders differently. Our results showed that female employees worked shorter hours a week compared to men, with many of them working fewer than 35 hours a week. Hence, the range of optima point of depressive disorder related to work hours were shown differently depending on gender. The large sample size allowed stratification by gender.

In Korea, there is a considerable imbalance between genders in the sharing of household chores. The total work hours of women appear to be greater and more distributed than men due to such hours of unpaid work. Even when women enter fulltime employment, they typically retain the main responsibility for childcare and housework. The average amount of time that women across OECD countries spent doing housework was 274 min each day; Korean women spent 227 min a day. In contrast, Korean men

spent only 45 min a day on average on housework, which was well below the OECD average of 139 min. In short, Korean women spent around 5 times more time doing housework compared to Korean men. (OECD.2015) Taking this into account, the total workload (both paid and unpaid work) for Korean women seems to be greater and more distributed compared to for men. (Shin, 2015) Furthermore, this study showed that the correlation between working hours and depressive symptoms for women is relatively smaller compared to that for men. Future studies should thus account for the unbalanced distribution of household chores between the genders.

Consistent with our results, Kleppa et al. (Kleppa et al., 2008) found an association between self-rated symptoms of depression and anxiety and LWH. Virtanen et al. (Virtanen et al., 2011) also found that working >55 h per week is associated with increased depressive symptoms. Sparks et al.'s meta-analysis found increased symptoms of mental illness among workers who work long hours (Sparks et al., 1997), In Korea, Kim et al. showed that depressive symptomatology and LWH are related using 2007-2009 KNHNE data. (Kim et al., 2013) Our results are therefore in line with these findings.

Several studies may support these findings. One mechanism suggested that depression could occur due to insufficient time available for recovery after working long hours, resulting in the accumulation of mental and physical fatigue. (Park et al., 2001) A negative relationship has also been found between overtime work and number of sleep hours. (Van der Hulst, 2003) Having poor-quality sleep including

a sleep disorder is more likely to lead to a depressive disorder due to the decreased activity of serotonin. (Kohyama, 2011) LWH additionally contribute to depressive disorder by exposing workers to work stress for longer. Overexposure to work stress leads to increased release of corticosteroid as a response to stress. Continuous increased release of corticosteroid directly affects brain activity and downregulates the glucocorticoid receptor. This affects mood and predisposes people to depressive mood.(Woo and Postolache, 2008) (Dahlgren et al., 2006)

Prospective studies have shown that sleep disturbances are closely linked to predictors of future depression (Anderson et al., 2009). Sleep hours have relevance to LWH as well as depressive disorder; hence, the number of sleep hours was a confounding factor. In the current study, the association between LWH and depressive disorder did not decrease after controlling for sleep hours. Therefore, depressive disorder is directly associated with LWH, rather than indirectly through hours of sleep.

Household income is a well-known indicator of socioeconomic status, which affects mental health. (Andersen et al., 2009) (Kahn et al., 2000) Kosidou et al.(2011) found that those in the lowest quartile with regard to household income are almost two times more likely to have severe psychological symptoms of distress and depression compared to those in the highest quartile. In the current study, after adjusting for covariant factors related to depressive disorder, household income was significantly related to depressive disorder. Furthermore, There was a statistically significant association between depressive disorder

and less working hours( $\leq 35$ ) in the male group before adjusting for household income, but it was not statistically significant in the male group with less working hours after adjusting the household income (Table 2). Thus, household income level is directly linked to depressive disorder more so for men than for women. However, past studies showed some inconsistencies regarding gender, and suggested that household income might have more serious effects on depressive disorder. (Kopp et al., 2000) (Schraedley et al., 1999).

Regarding occupational factors, some studies have showed that shift work and employment status are independently linked to workers' mental health. (Woo and Postolache, 2008) (Driesen et al., 2010) However, in the current study, shift work and employment status were not significantly associated to depressive disorder after adjusting for other factors. As few studies in Korea have investigated the relationship between occupational factors and mental illness using representative data, we anticipate further research between occupational factors and mental illness.

There were several limitations in this study. First, causal relationships between LWH and depressive disorder could not be determined, because of the nature of cross-sectional study designs. Second, the data used in this study were based on self-reports. Therefore, biases might have been present, including social desirability bias. Third, we did not include all of the possible factors associated to depressive disorder such as various chronic diseases and social activities.

## V. Conclusion

The results indicate that long working hours are associated with depressive disorder among employees in Korea. Especially, the prevalence rate of depressive disorder increases rapidly when the working time is very long (male > 65hr, female > 70hr). The relationship between long hours of work and depressive disorder is more significant in men than in women.

This study provides evidence supporting the recent policies passed by the Korean government to shorten working hours and enhance workers' mental health as well as physical health. In addition, this study has important implications for future policies. In developed countries such as the United States and Japan, workers assistance programs including mental health-related programs such as stress management play an important role in enhance workers' mental health.(Cooper et al., 2003 ),(Koo Hyo, 2012). However, in Korea, there is insufficient support for workers' mental and physical health despite the high prevalence of mental illness and the third-longest working hours among OECD countries.

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## ABSTRACT(IN KOREAN)

### 장시간 근로시간과 우울장애의 관계

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**서론:** 장시간 근로 시간은 근로자의 안전과 건강에 부정적인 영향을 미치고 생산성을 저하시킨다. 본 연구에서는 우울장애를 평가하는 PHQ-9 설문지를 이용한 2014년 국민 건강 영양 평가 자료를 분석하여 장시간 근로와 우울장애의 관계를 분석한다.

**방법:** 제 6 회 국민 건강 및 영양 조사 조사를 통해 PHQ-9 설문에 응답한 2014 년 1865 명의 근로자(남자: 931명, 여자; 932명) 의 데이터를

분석하였다. 인구학적 특징 및 건강행태, 직업적 특징을 보정 한 후 다변량 로지스틱 회귀분석을 통해 근로시간과 우울장애와의 관계를 조사하였다.

**결과:** 남성 근로자의 경우 주당  $\leq 35$ , 46-55, 56-65 또는  $\geq 65$  시간 근로하는 군에서 주당 36-45 시간 일하는 군에 비해 우울장애가 높다. (교차비 (95 % 신뢰 구간) : 4.45 (1.20-16.48), 3.39 (1.01-11.44) , 2.21 (0.44-11.17), 6.27 (1.53-25.34))

여성 근로자의 경우 주당 26-40 시간 일하는 사람에 비해 주당  $\leq 25$ , 40-55, 55-70,  $\geq 70$  시간 근로하는 군에서 우울장애 교차비 (95 % CIs)가 다음과 같이 나타났다. (1.65 (0.74-3.69), 0.95 (0.44-2.04), 0.74 (0.20-2.77), 7.12 (1.85-37.46))

**결론:** 한국의 근로자들에서 근로 표준시간 이상 장시간 근로군에서 우울장애 유병률이 높다. 특히, 우울 장애 유병률은 근로 시간이 매우 길 때 (남성 > 65 시간, 여성 > 70 시간) 급격히 증가한다. 또한 여성보다 남성에서 장시간 근로와 우울장애의 관련성이 유의하게 나타난다.

**핵심어:** 장시간 근로, 우울 장애, 단면 연구