

Original Article



# Association between working evening shifts and mental health among Korean employees: data from the 5th Korean Working Conditions Survey

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Abbreviations

AOR: adjusted odds ratio; CI: confidence interval; COR: crude odds ratio; GAD-7: Generalized Anxiety Disorder Screener; ILO: International Labor Organization; IRB: Institutional Review Board; K-ANX: Korean Screening Tool for Anxiety Disorders; KWCS-V:

## ABSTRACT

**Background:** Many studies have been conducted to investigate the harmful effect of shift work on physical and mental health. Although, by definition, “working evening shift” is included in the scope of shift work, most related studies conducted thus far have focused on working night shifts, overtime work, or different types of shift work, with little research effort dedicated to “working evening shifts.” Therefore, to fill this research gap, we investigated the effect of working evening shifts on workers’ mental health.

**Methods:** The participants of this study were 16,692 employees of the 50,205 that participated in the 5<sup>th</sup> wave of the Korean Working Conditions Survey. We performed  $\chi^2$  test and logistic regression analysis to analyze the effects of independent variables on health problems and calculated odds ratios and 95% confidence intervals (CIs).

**Results:** In the logistic regression analysis adjusted for sociodemographic characteristics, health-related factors, and work-related characteristics, employees who worked evening shifts showed higher levels of depression and anxiety compared to those that did not. In particular, the adjusted odds ratios of the group working evening shifts between one and nine times a month were the highest with 2.723 (95% CI: 2.014–3.682) for depression, 3.294 (95% CI: 2.547–4.259) for anxiety.

**Conclusions:** The results of our study suggest that working evening shifts has a negative effect on employees’ mental health. This trend decreased with an increase in the monthly frequency of evening work.

**Keywords:** Evening shift; Shift work; Mental health; Depression; Anxiety

## BACKGROUND

Long working hours and working overtime are common practices in today’s industrialized countries. Shift work refers to any work schedule other than the standard weekday working hours from 7 a.m. to 6 p.m., and working night shifts is required in all domains of an advanced economy.<sup>1,2</sup> In the US and EU, 20% of workers perform shift work.<sup>3</sup> In the field of occupational medicine, there has been a surge of research recently on the association between working hours and physical and mental health conditions.

5th wave of Korean Working Conditions Survey; OR: odds ratio; OSHRI: Occupational Safety and Health Research Institute; PHQ-9: 9-item Patient Health Questionnaire; WHO: World Health Organization.

#### Competing interests

The authors declare that they have no competing interests.

#### Author Contributions

Conceptualization: Heo SC. Data curation: Heo SC, Choi YL. Formal analysis: Heo SC. Supervision: Jeon MJ. Writing - original draft: Heo SC, Choi YL. Writing - review & editing: Heo SC, Jeon MJ.

The International Labor Organization (ILO) and the World Health Organization (WHO) have reported that people exposed to long working hours ( $\geq 55$  hours/week) have a 17% higher risk of death from ischemic heart disease and a 35% higher risk of death from stroke compared with people working the standard 35–40 hours/week.<sup>4</sup> Moreover, long working hours is a known risk factor for sleep disorders.<sup>5</sup> The ILO defines the term “working night shift” as “all work which is performed during a period of not less than seven consecutive hours, including the interval from midnight to 5 a.m., to be determined by the competent authority after consulting the most representative organizations of employers and workers or by collective agreements.”<sup>6</sup> Working night shift is associated with an increase in the incidence of breast cancer, cardiovascular diseases, and sleep disorders.<sup>7–9</sup> Previous research also reported a 2.8 times higher rate of prescription drug use for mood and anxiety disorders among workers suffering from insomnia.<sup>10</sup> As examined above, it is a well-established fact that working hours is associated with cardiovascular diseases, sleep disorders, depression, and anxiety.

In South Korea, the amendment bill of the Labor Standards Act to reduce the maximum weekly working hours from 68 hours to 52 hours passed the National Assembly plenary session in 2018. The statutory daily and weekly working hours for adult workers are 8 and 40 hours, respectively, and the major amendments include shortening working hours, allowing overtime work in special cases, and specifying the premium rates for night and holiday work.<sup>11</sup> These amendments were in line with the global effort to establish systems and regulations to protect workers’ right to health, with the association between working hours and workers’ physical and mental health demonstrated globally.<sup>12</sup>

A shift work schedule varies greatly and may include split shifts, permanent shifts, rotating shifts, and irregular working hours. Shift work and long working hours can have detrimental effects on the health of workers due to their impacts on psychosocial, behavioral, and physiological mechanisms. Psychosocially, it can cause difficulty in scheduling appropriate time for work and a decrease in work-life balance, and it may shorten the rest time for physical recovery from work. Biologically, it can disrupt endogenous human circadian rhythms such as melatonin secretion, thus promoting inflammation and oncogenesis, and exert immunosuppressive effects. It can also result in behavioral changes such as weight gain and smoking.<sup>2,13</sup>

As a fore mentioned, the detrimental effects of working night shifts and long working hours on workers’ physical and mental health have been demonstrated by many studies. Although shift work includes evening work by definition, studies on shift work have only dealt with night shifts and long working hours or different forms of shift work; thus, there is a paucity of research dedicated to the effect of working evening shift on workers’ health. Working evening shifts makes it difficult for workers to pursue hobbies and have leisure time during the week, and this deprives them of time for dinner with family and friends, which is particularly important for social connections and solidarity in many cultures. A study reported that people who have dinner alone have a 1.53-fold higher risk of depression compared with those who have dinner with their families.<sup>14</sup> Against this background, this study aimed to investigate the association between working evening shifts and mental health, with a focus on the effect of working between 6 p.m. and 10 p.m. on employees’ mental health, in terms of depression and anxiety.

## METHODS

### Participants

This study was conducted as a secondary analysis of data derived from the 5th wave of Korean Working Conditions Survey (KWCS-V) conducted in 2017 by the Occupational Safety and Health Research Institute (OSHRI) affiliated with the Korea Occupational Safety and Health Agency. As a representative survey that was designed to determine how social and psychological factors related to health, safety, and job stress and also workplace risk factors affect the working environment, the KWCS collected basic data to shed light on the Korean working environment. In KWCS-V, data collection was performed nationwide, by personal visits to conduct individual interviews with 50,205 workers aged 15 years and older.

Of the 50,205 participants in the KWCS-V survey, the present study included 16,692 workers aged 20 years and older. Those who were self-employed, business owners, or unpaid family workers were excluded from the study. Data fields that contained responses such as “don’t know/no response” or “refuse” responses were excluded from the analysis; application of standardization weights resulted in a final sample population of 21,684 respondents (12,876 males and 8,808 females).

### Main variables

In KWCS-V, data on evening shifts were collected by asking the questions “Do you work for two hours or longer between 6 p.m. and 10 p.m.?” and “If you do, how many days a month do you work an evening shift?” This study classified the answers to these items into the following four categories: 0, 1–9 times, 10–19 times, and 20 times or more per month.

Feelings of depression and anxiety were determined by dichotomous response (yes or no) to each of the three inquiry items: whether the respondents had health problems of depression and anxiety over the past 12 months.

### Covariates

The participants’ sociodemographic characteristics (sex, age, education, and income), health-related factors (self-rated health, chronic disease, difficulty falling asleep, frequent waking, and waking up with fatigue), and working environment factors (working night shifts, working on Sundays, working on Saturdays, working long hours, company size, working period, employment stability, job stress, job satisfaction, and coworker satisfaction) were set as covariates. The participants were stratified into four groups based on age: 20–39 years, 40–49 years, 50–59 years, and 60+ years. Educational level was dichotomized into “high school or lower” and “college or higher.” The average monthly income was classified into four categories: < 2 million won, 2 to 4 million won, 4 to 6 million won, and ≥ 6 million won. Self-rated health condition was dichotomized into “good” and “bad” for the question, “How do you perceive your general health condition?” Disease status was dichotomized into “yes” and “no” for the question, “Do you have a disease or health problem that has lasted or is likely to last for more than 6 months?” Sleep status was evaluated on a dichotomous scale of “yes” and “no”, indicated as a response to each of the following sleep status variables: difficulty falling asleep, frequent waking, and waking up with fatigue; the question being “Have you had any of the following sleep problems over the past 12 months?” Night shift was classified into four categories of 0, 1–9 times, 10–19 times, and 20 times or more per month depending on the response to the question “How many days a month do you work at least 2 hours between 10 p.m. and 5:00 a.m. the next morning?” Long working hours was classified in the same

way as night shift in response to the question “How many days a month do you work more than 10 hours a day?” Working on Saturdays and Sundays were classified into 0, 1, 2, and  $\geq 3$  times a month. Employment stability was dichotomized into “yes” and “no” for the question, “when the company is in trouble, can you continue to work if you want?” Company size was classified into three categories of 1–9, 10–249, 250 or more depending on the number of employee. Working period was classified into four categories of less than 1 year, 1–4 years, 5–9 years, and 10 or more years. Job stress was dichotomous scale of “low” and “high.” Job satisfaction dichotomous scale of “high” and “low” for the question, “what do you think about your overall working environment?” Coworker satisfaction dichotomous scale of “high” and “low” for the question, “do you get along well with your coworkers?”

### Statistical analysis

Statistical analysis of study data was performed using SPSS ver.25.0 (SPSS Inc., Chicago, IL, USA). For the analysis of the factors affecting the participants’ mental health, the  $\chi^2$  test and linear-by-linear association were performed using depression, anxiety as dependent variables; factors that had  $p$ -values of  $\leq 0.25$  with regard to depression or anxiety were further analyzed by a logistic regression analysis. Based on the analysis results, the effects of independent variables on health problems were estimated and the corresponding odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. Statistical significance was set at  $p < 0.05$ . ORs were calculated using different models by sequentially and cumulatively adjusting for sociodemographic factors, health-related factors, and working environment factors. OSHRI recommends the application of weights when analyzing KWCS raw data. Therefore, the weights were calculated by the ranking-ratio method presented in OSHRI.

### Ethics statement

This study was approved by the Institutional Review Board (IRB) of Dongguk University Gyeongju Hospital (IRB No. 110757-202203-HR-03-02).

## RESULTS

**Table 1** outlines the associations between participants’ sociodemographic characteristics and self-perceived mental health variables (depression, anxiety). A statistically significant difference was found between the sexes with respect to depression, with women ( $n = 194$ , 2.2%) showing a higher rate of depression than men ( $n = 216$ , 1.7%) ( $p = 0.005$ ). In terms of age, statistically significant differences were found among the different age groups for each of the mental health variables ( $p < 0.001$  for each). Younger participants ( $< 40$  years) showed the lowest proportions of affirmative responses to depression (1.5%), anxiety (2.0%). The highest rates of depression and anxiety were shown among the participants in their 40s (2.3%) and 50s (3.3%) respectively. Regarding education level, no significant difference was observed among the two categories for depression and anxiety. Statistically significant differences in terms of monthly income were observed only for anxiety, where by higher proportions of affirmative responses were received, paradoxically enough, from those with higher income ranges ( $\geq 6,000,000$  Korean Won [KRW], 6.7% and 4,000,000–5,990,000 KRW, 3.7%) than from those with lower income ranges ( $< 2,000,000$  KRW, 2.6% and 2,000,000–3,990,000 KRW, 2.0%) ( $p < 0.001$ ).

**Table 2** outlines the associations between participants’ health-related factors and self-perceived mental health. Most of the health-related factors showed statistically significant

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**Table 1.** Association between participant's sociodemographic characteristics and self-perceived mental health

Characteristics	Total (n = 21,684)	Depression		p-value <sup>a</sup>	Anxiety		p-value <sup>a</sup>
		Yes	No		Yes	No	
<b>Sex</b>							
Male	12,876 (59.4)	216 (1.7)	12,660 (98.3)		344 (2.7)	12,533 (97.3)	
Female	8,808 (40.6)	194 (2.2)	8,614 (97.8)	0.005	214 (2.4)	8,593 (97.6)	0.270
<b>Age (years)</b>							
< 40	9,827 (45.3)	144 (1.5)	9,683 (98.5)		196 (2.0)	9,631 (98.0)	
40–49	5,996 (27.7)	136 (2.3)	5,860 (97.7)		175 (2.9)	5,821 (97.1)	
50–59	4,348 (20.0)	97 (2.2)	4,251 (97.8)		144 (3.3)	4,204 (96.7)	
≥ 60	1,513 (7.0)	34 (2.2)	1,479 (97.8)	< 0.001	44 (2.9)	1,469 (97.1)	< 0.001
<b>Education level</b>							
High school or lower	6,943 (32.0)	148 (2.1)	6,795 (97.9)		187 (2.7)	6,756 (97.3)	
College or higher	14,741 (68.0)	262 (1.8)	14,479 (98.2)	0.074	371 (2.5)	14,370 (97.5)	0.442
<b>Monthly income (KRW)</b>							
< 2,000,000	5,226 (24.1)	125 (2.4)	5,101 (97.6)		138 (2.6)	5,088 (97.4)	
2,000,000–3,990,000	12,280 (56.6)	185 (1.5)	12,095 (98.5)		246 (2.0)	12,034 (98.0)	
4,000,000–5,990,000	3,553 (16.4)	67 (1.9)	3,486 (98.1)		132 (3.7)	3,421 (96.3)	
≥ 6,000,000	625 (2.9)	32 (5.1)	593 (94.9)	0.350	42 (6.7)	583 (93.3)	< 0.001

Values are expressed by number (%).

<sup>a</sup>Calculated by  $\chi^2$  test.

**Table 2.** Association between participant's health-related factors and self-perceived mental health

Variables	Total (n = 21,684)	Depression		p-value <sup>a</sup>	Anxiety		p-value <sup>a</sup>
		Yes	No		Yes	No	
<b>Self-perceived health condition</b>							
Good	21,432 (98.8)	388 (1.8)	21,044 (98.2)		543 (2.5)	20,889 (97.5)	
Bad	252 (1.2)	22 (8.7)	230 (91.3)	< 0.001	15 (6.0)	237 (94.0)	0.001
<b>Disease</b>							
No	21,081 (97.2)	341 (1.6)	20,740 (98.4)		489 (2.3)	20,592 (97.7)	
Yes	603 (2.8)	70 (11.6)	533 (88.4)	< 0.001	69 (11.4)	534 (88.6)	< 0.001
<b>Difficulty in falling asleep</b>							
No	20,831 (96.0)	371 (1.8)	20,460 (98.2)		511 (2.5)	20,320 (97.5)	
Yes	853 (4.0)	39 (4.6)	814 (95.4)	< 0.001	47 (5.5)	806 (94.5)	< 0.001
<b>Frequent waking</b>							
No	20,994 (96.8)	384 (1.8)	20,610 (98.2)		518 (2.5)	20,476 (97.5)	
Yes	690 (3.2)	26 (3.8)	994 (96.2)	< 0.001	40 (5.8)	650 (94.2)	< 0.001
<b>Waking up with fatigue</b>							
No	20,965 (96.7)	374 (1.8)	20,591 (98.2)		517 (2.5)	20,448 (97.5)	
Yes	719 (3.3)	36 (5.0)	683 (95.0)	< 0.001	41 (5.7)	678 (94.3)	< 0.001

Values are expressed by number (%).

<sup>a</sup>Calculated by  $\chi^2$  test.

associations with depression and anxiety. Participants who perceived their health condition as bad vs good had higher affirmative response rates for depression (8.7% vs. 1.8%) and anxiety (6.0% vs. 2.5%) ( $p < 0.001$  for both). Likewise, participants with vs without diseases had higher rates of depression (11.6% vs. 1.6%), anxiety (11.4% vs. 2.3%) ( $p < 0.001$  for both). In terms of sleep patterns, participants with vs without difficulty in falling asleep had higher levels of depression (4.6% vs. 1.8%) and anxiety (5.5% vs. 2.5%) ( $p < 0.001$  for both). Regarding frequent waking, those with versus without frequent waking had higher levels of depression (3.8% vs. 1.8%) and anxiety (5.8% vs. 2.5%) ( $p < 0.001$  for both).

**Table 3** provides details on the associations between participants' work-related factors and mental health-related factors such as depression and anxiety. Statistically significant results ( $p < 0.001$ ) were obtained in the relationship of each of the work-related factors with depression, anxiety. Regarding working night shifts, participants with no night work experience had the rates of depression (1.6%), anxiety (2.1%); those working night shifts

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**Table 3.** Association between participant's work-related factors and self-perceived mental health

Variables	Total (n = 21,684)	Depression		p-value <sup>a</sup>	Anxiety		p-value <sup>a</sup>
		Yes	No		Yes	No	
<b>Working night shifts (per month)</b>							
0	19,552 (90.2)	321 (1.6)	19,231 (98.4)		419 (2.1)	19,133 (97.9)	
1–9	1,078 (5.0)	54 (5.0)	1,024 (95.0)		92 (8.5)	986 (91.5)	
10–19	870 (4.0)	33 (3.8)	837 (96.2)		44 (5.1)	826 (94.9)	
≥ 20	184 (0.8)	2 (1.1)	182 (98.9)	< 0.001	4 (2.2)	180 (97.8)	< 0.001
<b>Working evening shifts (per month)</b>							
0	13,900 (64.1)	170 (1.2)	13,730 (98.8)		195 (1.4)	13,705 (98.6)	
1–9	3,611 (16.6)	137 (3.8)	3,474 (96.2)		209 (5.8)	3,402 (94.2)	
10–19	2,025 (9.3)	64 (3.2)	1,961 (96.8)		96 (4.7)	1,929 (95.3)	
≥ 20	2,148 (1.0)	38 (1.8)	2,110 (98.2)	< 0.001	58 (2.7)	2,090 (97.3)	< 0.001
<b>Working on Sundays (per month)</b>							
0	18,777 (86.6)	329 (1.8)	18,448 (98.2)		445 (2.4)	18,332 (97.6)	
1	462 (2.1)	16 (3.5)	446 (96.5)		22 (4.8)	440 (95.2)	
2	1,461 (6.7)	45 (3.1)	1,416 (96.9)		58 (4.0)	1,403 (96.0)	
≥ 3	984 (4.5)	20 (2.0)	964 (98.0)	< 0.001	32 (3.3)	952 (96.7)	< 0.001
<b>Working on Saturdays (per month)</b>							
0	13,058 (60.2)	223 (1.7)	12,835 (98.3)		273 (2.1)	12,785 (97.9)	
1	795 (3.7)	20 (2.5)	775 (97.5)		39 (4.9)	756 (95.2)	
2	2,852 (13.1)	77 (2.7)	2,775 (97.3)		94 (3.3)	2,758 (96.7)	
≥ 3	4,979 (23.0)	90 (1.8)	4,889 (98.2)	0.003	152 (3.1)	4,827 (96.9)	< 0.001
<b>Working long hours (per month)</b>							
0	16,955 (78.2)	252 (1.5)	16,703 (98.5)		318 (1.9)	16,637 (98.1)	
1–9	2,492 (11.5)	83 (3.3)	2,409 (96.4)		125 (5.0)	2,367 (95.0)	
10–19	924 (4.2)	42 (4.5)	882 (95.5)		70 (7.6)	854 (92.4)	
≥ 20	1,313 (6.1)	33 (2.5)	1,280 (97.5)	< 0.001	45 (3.4)	1,268 (96.6)	< 0.001
<b>Employment stability</b>							
Yes	20,474 (94.4)	390 (1.9)	20,084 (98.1)		539 (2.6)	19,936 (97.4)	
No	1,210 (5.6)	20 (1.7)	1,190 (98.3)	0.532	19 (1.6)	1,190 (98.4)	0.024
<b>Company size (employees)</b>							
1–9	7,388 (34.1)	119 (1.6)	7,269 (98.4)		157 (2.1)	7,231 (97.9)	
10–249	11,949 (55.1)	253 (2.1)	11,696 (97.9)		340 (2.8)	11,608 (97.2)	
≥ 250	2,347 (10.8)	38 (1.6)	2,309 (98.4)	0.256	61 (2.6)	2,287 (97.4)	0.021
<b>Working years</b>							
< 1	7,124 (32.9)	143 (2.0)	6,981 (98.0)		164 (2.3)	6,960 (97.7)	
1–4	5,311 (24.5)	105 (2.0)	5,206 (98.0)		140 (2.6)	5,171 (97.4)	
5–9	1,870 (8.6)	32 (1.7)	1,838 (98.3)		53 (2.8)	1,817 (97.2)	
≥ 10	7,379 (34.0)	131 (1.8)	7,248 (98.2)	0.248	201 (2.7)	7,178 (97.3)	0.114
<b>Job stress</b>							
Low	3,533 (16.3)	34 (1.0)	3,499 (99.0)		41 (1.2)	3,492 (98.8)	
High	18,151 (83.7)	376 (2.1)	17,775 (97.9)	< 0.001	517 (2.8)	17,634 (97.2)	< 0.001
<b>Job satisfaction</b>							
High	21,178 (97.7)	373 (1.8)	20,805 (98.2)		518 (2.4)	20,660 (97.6)	
Low	506 (2.3)	37 (7.3)	469 (92.7)	< 0.001	40 (7.9)	466 (92.1)	< 0.001
<b>Coworker satisfaction</b>							
High	20,782 (95.8)	389 (1.9)	20,393 (98.1)		520 (2.5)	20,262 (97.5)	
Low	902 (4.2)	21 (2.3)	881 (97.7)	0.381	39 (4.3)	863 (95.7)	0.001

Values are expressed by number (%).

<sup>a</sup>Calculated by  $\chi^2$  test.

1–9 times a month had the highest rates of depression (5.0%) and anxiety (8.5%). Regarding working evening shifts, the lowest rates of depression (1.2%) and anxiety (1.4%) were observed in participants who did not work evening shifts, and the highest rates of depression (3.8%) and anxiety (5.8%) were observed in participants working evening shifts 1–9 times a month. Likewise, the lowest rates of depression and anxiety were observed in participants who did not work on Sunday or Saturday or had long work hours. Participants who answered their job stress as high vs low had higher affirmative response rates for depression (2.1% vs.

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**Table 4.** OR for self-perceived mental health according to working evening shifts per one month

Self-perceived mental health	Working evening shifts per one month						
	0	1–9, OR (95% CI)	<i>p</i> -value	10–19, OR (95% CI)	<i>p</i> -value	≥ 20, OR (95% CI)	<i>p</i> -value
<b>Depression</b>							
Crude	1.000	2.988 (2.454–3.640)	< 0.001	2.669 (2.090–3.409)	< 0.001	1.585 (1.183–2.124)	0.002
Model 1	1.000	3.256 (2.666–3.978)	< 0.001	2.810 (2.193–3.602)	< 0.001	1.649 (1.227–2.215)	< 0.001
Model 2	1.000	3.074 (2.506–3.771)	< 0.001	2.618 (2.032–3.372)	< 0.001	1.507 (1.115–2.038)	0.008
Model 3	1.000	2.723 (2.014–3.682)	< 0.001	1.967 (1.312–2.950)	0.001	1.434 (0.942–2.184)	0.092
<b>Anxiety</b>							
Crude	1.000	3.569 (3.019–4.219)	< 0.001	3.032 (2.462–3.733)	< 0.001	1.836 (1.437–2.345)	< 0.001
Model 1	1.000	3.693 (3.117–4.375)	< 0.001	3.063 (2.480–3.784)	< 0.001	1.903 (1.486–2.438)	< 0.001
Model 2	1.000	3.548 (2.989–4.212)	< 0.001	2.937 (2.372–3.637)	< 0.001	1.796 (1.398–2.307)	< 0.001
Model 3	1.000	3.294 (2.547–4.259)	< 0.001	2.366 (1.687–3.318)	< 0.001	1.726 (1.214–2.455)	0.002

OR: odds ratio; CI: confidence interval.

Model 1: adjusted by sex, age, education, income; Model 2: adjusted by sex, age, education, income, self-rated health, chronic disease, difficulty falling asleep, frequent waking, waking up with fatigue; Model 3: adjusted by sex, age, education, income, self-rated health, chronic disease, difficulty in falling asleep, frequent waking, waking up with fatigue, working night shifts, working Sundays, working Saturdays, working long hours, company size, working period, employment stability, job stress, job satisfaction, coworker satisfaction.

1.0%) and anxiety (2.8% vs. 1.2%). Participants who answered their job satisfaction as low vs high had higher affirmative response rates for depression (7.3% vs 1.8%) and anxiety (7.9% vs. 2.4%). Likewise, participants who answered their coworker satisfaction as low vs high had higher affirmative response rates for anxiety (4.3% vs. 2.5%).

**Table 4** presents the crude odds ratios (CORs) calculated by a logistic regression analysis and the adjusted odds ratios (AORs) for socioeconomic factors (sex, age, education, income), health-related factors (self-rated health, chronic disease, difficulty falling asleep, frequent waking, waking up with fatigue), and working environment factors (working night shifts, working on Sunday, working on Saturday, working long hours, company size, working period, employment stability, job stress, job satisfaction, coworker satisfaction). Models for adjusting ORs comprised factors that showed significant associations with the mental health variables in the cross-tabulation analysis performed previously on this study. First, the CORs were calculated, and then Models 1 to 3 were constructed to adjust for sociodemographic, health-related, and work environmental factors, respectively, by sequentially and cumulatively adding the corresponding sets of variables, to derive the final results. In Models 1 and 2, working evening shifts was confirmed to significantly affect the levels of depression and anxiety. In Model 3, in which two sets of variables were adjusted for, the group working evening shifts 1–9 times a month showed the statistically significant AORs for depression 2.723 (95% CI: 2.014–3.682) and anxiety 3.294 (95% CI: 2.547–4.259) ( $p < 0.001$  for both). The group working evening shifts 10–19 times a month showed statistically significant AORs for depression 1.967 (95% CI: 1.312–2.950) and anxiety 2.366 (95% CI: 1.687–3.318) ( $P < 0.001$  for both). The group working evening shifts 20 times or more in a month showed a statistically significant AOR for anxiety 1.726 (95% CI: 1.214–2.455) ( $p = 0.002$ ), with changes in depression reaching no statistical significance.

## DISCUSSION

The levels of depression, anxiety were higher among the participants who worked evening shifts than among those who did not work evening shifts. Torquati et al.<sup>15</sup> reported that working outside the standard working hours (from 7 a.m. to 6 p.m.) has a detrimental effect on mental health (effect size = 1.28; 95% CI: 1.02–1.62), demonstrating that research focusing on working evening hours demonstrates a finding that evening shift has a negative effect on

mental health. The increased ORs remained significant after adjustment for the participants' sociodemographic characteristics, health-related factors, and working environment factors.

However, the AORs for depression, anxiety were highest in the group working on evening shifts 1–9 times a month and decreased with increase in the frequency of evening shifts. Specifically, no linear increase was observed in the relation between the effect of working evening shifts on mental health and the frequency of working evening shifts. In a study by Ulhôa et al.,<sup>16</sup> irregular shift work was found to be correlated with an increase in stress response. Likewise, Zhao et al.<sup>17</sup> found that the association between shift work and mental health varies depending on the type of shift work, with the strongest evidence obtained in relation to irregular or unpredictable shift work. In a study by Barton,<sup>18</sup> the nurses on rotating shifts reported significantly more social disruption and more sleep difficulties between successive night shifts than did the permanent night shift nurses. In terms of circadian characteristics, the permanent night shift was at an advantage in comparison with the rotating shifts. In this study, the group working on evening shifts 1–9 times a month seems to have shown the highest risk of mental health problems in that daily life is more irregular because they alternately perform the work at different times.<sup>18</sup> The group working on evening shifts more than 20 times a month seems to have a working type that is close to fixed shift, whereas the group working on evening shifts 1–9 times a month is thought to have very irregular shifts. Therefore, it is considered that intermittency and irregularity rather than frequency of evening work as factors that deteriorate employees' mental health.

The results of previous research on the effects of shift work on depression were consistent with the effects of evening work on depression verified in the current study. Torquati et al.<sup>15</sup> found a particularly strong association between shift work and depressive symptoms among mental health problems. In this study, a meta-analysis of seven longitudinal studies, including a study with 28,431 was performed, and the effect sizes of the effects of shift work on depression and anxiety were calculated. The effect of shift work on depression calculated by Torquati et al.<sup>15</sup> was 1.33 (95% CI: 1.02–1.74), and other study reported 1.13 (95% CI: 1.14–1.55).<sup>15,19</sup> Working evening shifts is a part of shift work, and similar tendencies are observed between these studies on shift work and the current study on working evening shifts, although they cannot be directly compared because the current study analyzed evening shifts in different frequency categories.

The effect of shift work on anxiety calculated by Torquati et al.<sup>15</sup> was 1.2 (95% CI: 0.85–1.69), the risk of anxiety was higher in shift workers. However, unlike this study, these associations were not statistically significant. A study investigating shift work and anxiety explained that shift work disrupts the circadian rhythm in the human body, which impairs sleep quality and causes anxiety.<sup>20</sup> Shift work disturbed the circadian melatonin rhythm and causes sleep disturbance, and it worsens the symptoms of depression and anxiety. Melatonin has been implicated in several behavioral processes including pain perception, anxiety- and depression-like behaviors, as well as general arousal. A disturbed circadian melatonin rhythm and decreased exposure to daylight have also been related to depression.<sup>21,22</sup> Since this study investigated anxiety in relation to working evening shifts, it is difficult to attribute anxiety to sleep quality based on its results. However, it was pointed out in previous research that various factors including job stress and social stress are involved in the relationship between shift work and anxiety.<sup>23</sup> For a clear causal relationship to be established, the association between shift work and anxiety symptoms needs to be clarified in further studies.



Job stress is the process by which psychological experiences and demands (stressors) of the workplace produce both short-term (strains) and long-term changes in mental and physical health.<sup>24</sup> In an era of heightened downsizing, work intensification, and resource rationalization, this trend is seemingly here to stay.<sup>25,26</sup> According to models formulated based on the work-related stress risk assessment as per the EU-OSHA's report (2000), psychosocial hazards related to jobs include work environment and equipment, workload and workplace, work schedule, task design, and emotional demands.<sup>27</sup>

Therefore, work schedule is an important factor that should be included in the evaluation of job stress. The effect of shift work on job stress has been demonstrated by many previous studies.<sup>28,29</sup> In Kim et al.'s study,<sup>30</sup> the average job stress of shift workers was significantly higher than that of non-shift workers (3.4 vs. 3.16 out of 5 points). The current Korean working hour schemes center on long working hours and night shifts.<sup>11</sup> However, the finding of this study that working evening shifts affects employees' mental health highlights the need to draw attention to working evening shifts as a part of shift work. There is a research finding that the incidence of mental disorders and obesity in children and adolescents decreases with an increase in the frequency of family dinner.<sup>31</sup> Therefore, institutional and social efforts need to be directed towards transforming evening work into daytime work whenever possible as this would benefit not only individual workers but also family well-being while improving corporate productivity. In addition, when evening work is inevitable, given its detrimental effects on employees, an appropriate compensation system and mental health evaluation are necessary.

This study had some limitations. First, as this was a cross-sectional study, no causal relationship could be established, although statistically significant associations could be verified between evening work variables (incidence and frequency) and mental health conditions (depression and anxiety). In particular, to explain the tendency of the decrease in this negative effect of working evening shifts with an increase in its frequency, additional longitudinal research needs to be conducted with a focus on the regularity and predictability of working hours. Second, the incidence of depression and anxiety was determined by self-reported questionnaires instead of using objective diagnostic results or assessment tools. The 9-item Patient Health Questionnaire (PHQ-9),<sup>32</sup> the Korean version of PHQ-9,<sup>33,34</sup> the Generalized Anxiety Disorder Screener (GAD-7),<sup>35</sup> the Korean Screening Tool for Anxiety Disorders (K-ANX)<sup>36</sup> are all reliable assessment tools to screen for anxiety disorders in Korean samples. Third, since the occupation-specific characteristics could not be reflected in the analysis, the results of this study cannot be directly generalized to employee groups divided into white and blue-collared workers and to different occupation groups.

Despite these limitations, this study has the merit of analyzing the association between working evening shifts and mental health among Korean employees for the first time. Since the nationwide collected data from KWCS-V were used, the results of this study can be reliably applied to the general population. Although existing studies have partially dealt with evening shifts, the main focus was on the forms of shift work in specific occupations such as nursing.<sup>28,37-40</sup> The significance of this study lies in the fact that it drew significant results after adjustment for the effects of night shift work and long working hours among the general population.

## CONCLUSIONS

The results of this study showed that there exists a significant association between working evening shifts and employees' poor mental health. In addition, a tendency towards a decrease in this effect was observed with an increase in the frequency of evening shifts, which allows us to make the inference that it is not so much the frequency of evening work but its intermittency and irregularity that deteriorates employees' mental health. To obtain a more accurate causal relationship between the frequency of evening work and mental health problems, additional longitudinal studies are needed. Unpaid housework has the same effect on depression as paid work when the quality of work is the same.<sup>41</sup> Therefore, an additional study is considered necessary to include unpaid family workers in the scope of analysis.

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