Annals of Occupational and
Environmental Medicine AOEM

Research Article

Comparing risk of depression between day and night/shift workers using the PHQ-9: a study utilizing the 2014, 2016, and 2018 Korea National Health and Nutrition Examination Survey data

ORCID iDs
Jae-Han Lee 🔟
https://orcid.org/0000-0002-6176-9142
Sang-Woo Kim 🔟
https://orcid.org/0000-0002-6963-9393
Jae-Han Joo 🔟
https://orcid.org/0000-0003-2043-8491
Na-Rae Lee 🔟
https://orcid.org/0000-0002-2679-9813
June-Hee Lee 🔟
https://orcid.org/0000-0002-7682-6023
Kyung-Jae Lee 🔟
https://orcid.org/0000-0001-5759-2367

Jae-Han Lee 🔟, Sang-Woo Kim 🔟, Jae-Han Joo 🔟, Na-Rae Lee 🔟, June-Hee Lee 🔟, and Kyung-Jae Lee 🔟 *

Department of Occupational and Environmental Medicine, Soonchunhyang University Hospital, Seoul, Korea

ABSTRACT

Background: In today's work scenario, the number of shift workers, including those in night shifts, is increasing. Shift work can adversely affect workers' health in the long run, but studies on the relationship between shift work and depression have shown inconsistent results. This study aimed to determine whether the number of night/shift workers at risk of depression, as predicted by the Patient Health Questionnaire-9 (PHQ-9), is higher than that of day workers.

Methods: This study was conducted based on data from the 6th and 7th Korea National Health and Nutrition Examination Survey, 2014, 2016, and 2018. Work schedules were classified into 2 types: day work and night/shift work. This study used the PHQ-9, a self-reported depression screening test, to identify workers at risk of depression. Statistical analysis was performed using SPSS 26.0, and descriptive statistics, χ^2 test, and logistic regression analysis were employed.

Results: After adjusting for age, educational level, working hours per week, and income, men engaging in night/shift work were at a higher risk of depression (odds ratio [OR]: 1.407, 95% confidence interval [CI]: 0.937–2.113). The same was confirmed for women (OR: 1.564, 95% CI: 1.176–2.081).

Conclusions: Our results showed that the OR for those engaged in night/shift work with a PHQ-9 score of 10 or more increased. Considering the large volume of psychiatric history and symptoms in Korea, additional research is needed. Additionally, further discussion on ways to provide realistic help to night/shift workers is warranted.

Keywords: Day work; Shift work; Night work; PHQ-9; Depression

BACKGROUND

In today's work scenario, the requirement for shift workers, including night shifts is increasing. Currently, about 15%–20% of workers in Europe and the United States are engaged in shift work, including night work.[1] According to the Work Environment Survey

Author contributions
Conceptualization: Lee JH[1], Lee NR; Data curation: Lee JH[1], Kim SW, Joo JH, Lee NR; Formal analysis: Lee JH[1], Lee NR; Supervision: Lee KJ, Lee JH[2]; Writing - original draft: Lee JH[1]; Writing - review & editing: Lee JH[1].

Lee JH[1], Jae-Han Lee; Lee JH[2], June-Hee Lee.

conducted by the Korea Occupational Safety and Health Agency, the proportion of shift workers among domestic workers was 7.1%, 7.2%, and 9.7% in 2014, 2015, and 2017, respectively, showing a gradual increase.[2]

Depression is highly associated with suicide, and it has been found that many of those who died by suicide were suffering from depression at the time of death.[3] According to the statistics on causes of death in 2019 compiled by the National Statistical Office in Korea, suicide ranked number one among those in their teens, 20s, and 30s, and number 2 among those in their 40s and 50s.[4] When comparing the age-standardized suicide rate, it can be seen that Korea has the highest suicide rate at 24.6, compared with the Organisation for Economic Co-operation and Development average of 11.3.

Shift work can adversely affect workers' health in the long run. It is known to significantly increase the incidence of gastrointestinal diseases and symptoms in comparison to consistent daytime work.[5] In addition to breast cancer and cardiovascular diseases,[6,7] recent studies have reported that shift work can increase the incidence of chronic inflammatory diseases such as asthma.[8]

As such, studies are being conducted on the physical and mental effects of night and shift (hereafter "night/shift") work in various occupations; however, research on the effects on mental health is insufficient compared with that on the effects on physical health,[9] and studies on the relationship between shift work and depression have shown inconsistent results.

For example, a population-based study of 277,168 workers in the UK biobank showed that shift workers were more likely to be obese, depressed, to report disturbed sleep, and to have neurotic traits.[10] A number of cross-sectional studies of workers in specific occupations, such as nurses, have suggested a relationship between night and shift work and depressive symptoms.[11,12] However, a 10-year observational cohort study showed contrary evidence, wherein being engaged in present or previous night work was not associated with sickness absence due to mental health problems.[13] Some observational studies reported that there was no significant association between night/shift work and depression.[14,15]

There is also a meta-analysis on the subject, but in this analysis, the authors stated that the study included a small number of observational studies to draw definite conclusions because of a paucity of data. Therefore, further case-control studies and prospective cohort studies are warranted.[16]

The proportion of night/shift workers among domestic workers is constantly rising, and with studies on the relationship between shift work and depression showing inconsistent results, the impact of work type on workers' mental health can be difficult to grasp. With the importance given to the prevention and treatment of depression in Korea, clearly understanding the relationship between night/shift work and depression will likely become even more crucial in the future.

In the present study, using the Korea National Health and Nutrition Examination Survey (KNHANES), we aimed to determine whether the number of night/shift workers at risk of depression, as predicted by the Patient Health Questionnaire-9 (PHQ-9), is higher than that of day workers.

METHODS

Data sources & study population

This study was conducted based on data from the National Health and Nutrition Survey, which examined 10,851 adults aged 20 years and above in the 6th and 7th (2014, 2016, and 2018) KNHANES. Of the total 22,328, 819 people diagnosed with depression by a doctor, and 4,720 aged under 20 were excluded, as were the 5,938 people who checked "Not applicable" or did not respond to the question (**Fig. 1**).

Exposure assessment

Shift work was defined by the KNHANES as a work schedule outside usual working hours (6 a.m.–6 p.m.), and night work as working through sleeping hours (9 p.m.–8 a.m.). Other working schedules such as evening work (2 p.m. to 12 midnight), 24-hour shift work, and irregular shift work were included as night/shift work.

General characteristics included gender and age (< 30, 30–39, 40–49, 50–59, and ≥ 60 years), educational level (below elementary school, middle school graduate, high school graduate, and university graduate or higher), alcohol consumption (less than once a month, more than twice a month), and smoking (no smoking experience, non-smoker, smoker). Occupational characteristics included work-related moderate-intensity physical activity, weekly working hours (less than 52, more than 52), and quartile of personal income.

Outcome assessment

In our study, based on characteristics related to mental health, a risk of depression of less than 10 points indicated low-risk, and 10 points or more indicated high-risk. This was based on the Korean version of the PHQ-9, where the following stress perception levels were used: 1) I feel too stressed; 2) I feel stressed quite a bit; 3) I feel stressed slightly; and 4) I hardly feel stressed. Depression level was categorized as high (1 and 2) or low (3 and 4), and history of counseling for mental problems within a year were included.

The PHQ-9 was developed by Spitzer et al. to evaluate depression in primary healthcare centers, and its modified Korean version has been used as a depression screening tool in clinical practice. Although the PHQ-9 is not a tool for diagnosing major depressive disorder,
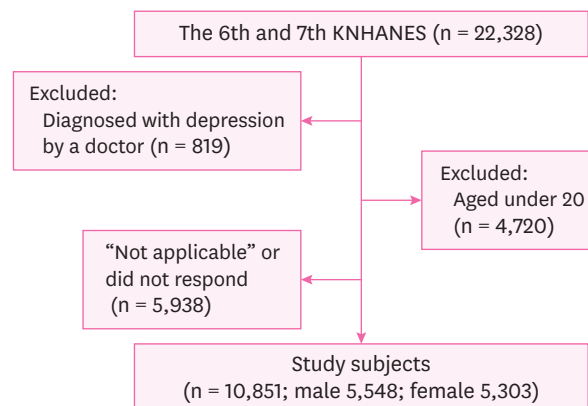

Fig. 1. Flow chart of the selection of study subjects.
KNHANES: Korea National Health and Nutrition Examination Survey.

various studies have shown that those with a score of 10 or more can be considered to be at high-risk of major depressive disorder.[17]

Statistical analysis

Statistical analysis was performed using SPSS 26.0 (IBM Inc., Armonk, NY, USA), and descriptive statistics, χ^2 test, and logistic regression analysis were used as statistical methods. The significance level was set at $p < 0.05$. First, the general characteristics of day work and night/shift work were compared using a χ^2 test. After that, the study sample was divided based on gender (male and female), and a χ^2 test was conducted to assess the degree of risk of depression and stress perception.

Finally, through logistic regression analysis, the odds ratio (OR) for high-risk of depression and high stress perception level in night/shift work compared with day work was confirmed.

RESULTS

Table 1 compares the general characteristics of the day and night/shift work groups using a χ^2 test. In terms of gender, there were no significant differences between the 2 groups. In the day work group, the proportion of those aged 60 or above was high, while in the night/shift work group, the proportion of those aged under 30 was high. In terms of education, the number of middle school and elementary school graduates was higher in the day work group than in the other groups, and there was no significant difference between the 2 groups with respect to alcohol consumption, smoking, manual labor, and personal income quartile. For the night/shift work group, weekly working hours exceeded 52 hours more often.

Risk of depression based on the PHQ-9 was found to be higher in the night/shift work group. However, there was no significant difference in the stress perception level and counseling for mental problems within one year between the 2 groups.

Table 2 compares the proportion of men and women at risk of depression and the degree of stress perception according to day and night shift work. A PHQ-9 score of 10 or higher was more common in the night/shift work group than in the day work group for both men and women. With respect to perceived stress, there was no difference between the genders irrespective of their work type (i.e., day work or night/shift work).

Table 3 shows the ORs for risk of depression and high stress perception level for night/shift work compared with day work. After adjusting for age, educational level, working hours per week, and income, men engaging in night/shift work were at a significantly higher risk of depression (OR: 1.407, 95% confidence interval [CI]: 0.937–2.113). The same was confirmed for women (OR: 1.564, 95% CI: 1.176–2.081). Stress perception level, on the other hand, was not found to be high for both men (OR: 0.932, 95% CI: 0.785–1.107) and women (OR: 0.947, 95% CI: 0.806–1.113) in the night/shift work group. This reveals that even though a large number of night/shift workers are at risk of depression, stress perception, which can also be interpreted by self-identification of depression, is low.

Table 1. General characteristics of day and night/shift work groups (n = 10,851)

Characteristics	Day work	Night/Shift work	p value[*]
Sex			0.096
Male	4,667 (51.5)	881 (49.3)	
Female	4,398 (48.5)	905 (50.7)	
Age			< 0.001
< 30	980 (10.8)	405 (22.7)	
30–39	1,791 (19.8)	306 (17.2)	
40–49	2,064 (22.8)	357 (20.0)	
50–59	2,005 (22.2)	379 (21.3)	
≥ 60	2,193 (24.3)	336 (18.8)	
Education			< 0.001
≤ Elementary school	1,418 (15.7)	194 (10.9)	
Middle school	900 (10.0)	148 (8.3)	
High school	2,880 (31.9)	795 (44.6)	
≥ College	3,832 (42.4)	646 (36.2)	
Alcohol consumption			0.683
≤ Once a month	4,402 (48.7)	858 (48.2)	
≥ Twice a month	4,631 (51.3)	922 (51.8)	
Smoking			0.059
Never-smoker or ex-smoker	7,013 (77.7)	1,347 (75.6)	
Current smoker	2,015 (22.3)	434 (24.4)	
Occupation			0.519
Non-physical	8,146 (89.9)	1,597 (89.4)	
Physical	913 (10.1)	189 (10.6)	
Weekly working hours			< 0.001
≤ 52 hours	7,230 (79.8)	1,358 (76.0)	
> 52 hours	1,834 (20.2)	428 (24.0)	
Personal income quartile			0.054
Low	1,981 (21.9)	397 (22.2)	
Middle low	2,350 (26.0)	496 (27.8)	
Mlddle high	2,349 (26.0)	479 (26.8)	
High	2,366 (26.2)	413 (23.1)	
Risk group for depression			< 0.001
Low risk group	8,708 (96.4)	1,682 (94.3)	
High risk group	325 (3.6)	101 (5.7)	
Stress perception level			0.505
Low	6,670 (73.9)	1,302 (73.1)	
High	2,360 (26.1)	479 (26.9)	
Counseling for mental problems within one year			0.862
No	6,358 (98.5)	1,260 (98.6)	
Yes	95 (1.5)	18 (1.4)	

[*]Calculated by χ^2 test.

Table 2. The proportion of men and women at risk of depression and the degree of stress perception according to day and night/shift work

Variables	Depression risk		p value[*]	Stress perception		p value[*]
	Low risk	High risk		Low	High	
Male			0.031			0.57
Day work	4,545 (97.6)	111 (2.4)		3,525 (75.8)	1,123 (24.2)	
Night/Shift work	846 (96.4)	32 (3.6)		658 (74.9)	220 (25.1)	
Female			0.001			0.783
Day work	4,163 (95.1)	214 (4.9)		3,145 (71.8)	1,237 (28.2)	
Night/Shift work	836 (92.4)	69 (7.6)		644 (71.3)	259 (28.7)	

[*]Calculated by χ^2 test.

DISCUSSION

Through this study, we investigated the effect of night/shift work on workers' PHQ-9 scores, and the determination of the OR for risk of depression among workers.

Table 3. OR and 95% CIs for high risk group and stress perception

Variables	High risk group	OR (95% CI)	Stress perception	OR (95% CI)
Model 1[a]				
Male	Day work	Reference	Day work	Reference
	Night/Shift work	1.549 (1.038–2.311)	Night/Shift work	1.049 (0.888–1.240)
Female	Day work	Reference	Day work	Reference
	Night/Shift work	1.606 (1.212–2.127)	Night/Shift work	1.023 (0.873–1.198)
Model 2[b]				
Male	Day work	Reference	Day work	Reference
	Night/Shift work	1.407 (0.937–2.113)	Night/Shift work	0.932 (0.785–1.107)
Female	Day work	Reference	Day work	Reference
	Night/Shift work	1.564 (1.176–2.081)	Night/Shift work	0.947 (0.806–1.113)

Calculated using multiple logistic regression analysis.
OR: odds ratio, CI: confidence interval.
[a]Crude odds ratio; [b]Adjusted by age, education, working hour, income.

Our results showed that the OR for those engaged in night/shift work with a PHQ-9 score of 10 or more increased. While most previous studies conducted on this topic so far have shown that night/shift work increases the likelihood of depression, there are cases that do not show significant results. A 10-year observational cohort study showed that being engaged in present or previous night work was not associated with sickness absence due to mental health problems.[13] In a 2013 cross-sectional study of 5,400 nurses in Norway, no association was observed between night work and depression.[18] The present study supports the case that night/shift work is likely to cause depression in workers.

Biological mechanisms that show that night/shift work may be associated with depression include the following: first, environmental stress, such as night/shift work, decreases the methylation of the promoter of the serotonin transporter gene (SLC6A4), reducing the amount of extracellular serotonin in the synaptic gap, which can lead to mental disorders such as depression[19]; and disruptions in glucocorticoid oscillations consistent with the biological clock every 24 hours may cause a signaling problem between neurons along with a decrease in synapses, leading to depression.[20] Our study shows similar results to support those of existing studies—that shift work can cause depression—and it is meaningful in that it shows the reproducibility of similar risks in Korean workers.

The limitations of the present study are as follows. First, the cross-sectional design of the study precludes any causal inferences. In addition, the shift workers included in this study might represent a relatively healthy part of the working population, and the participants in this study may have already adapted to their work schedule before the start of the survey.

The greatest strength of this study is that it was population-based; it uses large-scale data from the KNHANES, so it can be said that it provides meaningful results even though it is a cross-sectional study. Most cross-sectional studies that show the relationship between night/shift work and depression are based on certain occupational groups such as nurses, and those groups may experience depression due to the intensity of work and the stressful nature of the work itself.[21]

In addition, this study used the PHQ-9, which has high reliability as a depression screening tool for those at high-risk of depression. Considering the current psychiatric approach to depression in Korea and the fact that the diagnosis rate is remarkably low, the identification of those at high-risk of depression through the PHQ-9 could play an important role in the screening of night/shift workers.[22]

This study also shows that self-identification of depressive symptoms among night/shift workers in Korea is low. It is known that less self-identification of depressive symptoms can lead to lower requests for professional help for treatment.[23,24] This could also explain why there was no significant difference in counseling for mental problems within one year between the 2 groups. Considering the high suicide rate in Korea, finding this kind of "missed" depression could help reduce the overall suicide rates. However, this result should be interpreted with some caution, as workers with high stress perception are more prone to earlier retirement of the work, thus leading to a "healthy worker survivor effect." Therefore, additional research on when respondents enter into day and night/shift work is needed in the future.

The results of this study can be summarized as follows: Existing studies show that night/shift work increases the likelihood of depression, and there are theories that can explain this through biological mechanisms. However, as some studies show different results, further research is needed on the relationship between night/shift work and depression. In our study, the number of night/shift workers at risk of depression was significantly higher, with a PHQ-9 score of 10 or more, than that of day workers.

Furthermore, it is also necessary to pay attention to the additional information obtained during the research—that night/shift work did not affect the stress perception level and did not affect depression-related counseling within one year. This could mean that self-identification of depressive symptoms among night/shift workers in Korea is low, and thus led to lower requests for professional help for treatment. Considering the current volume of psychiatric history and symptoms in Korea, further discussion on ways to provide realistic help to night/shift workers is needed. For example, providing regular screening tests for depression among night/shift workers in Korea could help to provide appropriate professional help, thus leading to lower depression and suicide rates among night/shift workers.

CONCLUSIONS

This study investigated the association between night/shift work and depression. Despite its limitations, this study provides evidence for the association between night/shift work and depression. Considering the trend that the number of night/shift workers and suicide deaths continues to increase in Korea, further discussions and realistic help for domestic workers will be needed.

ACKNOWLEDGEMENTS

REFERENCES

1. Parent-Thirion A, Biletta I, Cabrita J, Vargas O, Vermeylen G, Wilczynska A et al. *Sixth European Working Conditions Survey: Overview Report*. Dublin, Ireland: European Foundation for the Improvement of Living and Working Conditions; 2016.

2. Korea Occupational Safety and Health Agency. Work environment survey. https://oshri.kosha.or.kr/oshri/researchField/downWorkingEnvironmentSurvey.do#. Updated 2019. Accessed May 26, 2021.

3. Takahashi Y. Depression and suicide. Japan Med Assoc J 2001;44(8):359-63.

4. Statistics Korea. Statistics on causes of death. http://kostat.go.kr/portal/korea/kor_nw/1/6/2/index.board?bmode=read&bSeq=&aSeq=385219&pageNo=1&rowNum=10&navCount=10&currPg=&searchInfo=&sTarget=title&sTxt=. Updated 2020. Accessed May 26, 2021.

5. Knutsson A, Bøggild H. Gastrointestinal disorders among shift workers. Scand J Work Environ Health 2010;36(2):85-95.
   PUBMED | CROSSREF

6. Cordina-Duverger E, Menegaux F, Popa A, Rabstein S, Harth V, Pesch B, et al. Night shift work and breast cancer: a pooled analysis of population-based case-control studies with complete work history. Eur J Epidemiol 2018;33(4):369-79.
   PUBMED | CROSSREF

7. Knutsson A, Akerstedt T, Jonsson BG, Orth-Gomer K. Increased risk of ischaemic heart disease in shift workers. Lancet 1986;2(8498):89-92.
   PUBMED | CROSSREF

8. Maidstone RJ, Turner J, Vetter C, Dashti HS, Saxena R, Scheer FAJL, et al. Night shift work is associated with an increased risk of asthma. Thorax 2021;76(1):53-60.
   PUBMED | CROSSREF

9. Vogel M, Braungardt T, Meyer W, Schneider W. The effects of shift work on physical and mental health. J Neural Transm (Vienna) 2012;119(10):1121-32.
   PUBMED | CROSSREF

10. Wyse CA, Celis Morales CA, Graham N, Fan Y, Ward J, Curtis AM, et al. Adverse metabolic and mental health outcomes associated with shiftwork in a population-based study of 277,168 workers in UK biobank. Ann Med 2017;49(5):411-20.
    PUBMED | CROSSREF

11. Chaiard J, Deeluea J, Suksatit B, Songkham W, Inta N, Stone TE. Sleep disturbances and related factors among nurses. Nurs Health Sci 2019;21(4):470-8.
    PUBMED | CROSSREF

12. Kang MY, Kwon HJ, Choi KH, Kang CW, Kim H. The relationship between shift work and mental health among electronics workers in South Korea: a cross-sectional study. PLoS One 2017;12(11):e0188019.
    PUBMED | CROSSREF

13. Norder G, Roelen CAM, Bültmann U, van der Klink JJL. Shift work and mental health sickness absence: a 10-year observational cohort study among male production workers. Scand J Work Environ Health 2015;41(4):413-6.
    PUBMED | CROSSREF

14. Berthelsen M, Pallesen S, Magerøy N, Tyssen R, Bjorvatn B, Moen BE, et al. Effects of psychological and social factors in shiftwork on symptoms of anxiety and depression in nurses: a 1-year follow-up. J Occup Environ Med 2015;57(10):1127-37.
    PUBMED | CROSSREF

15. Maghsoudipour M, Saberi H. Sleep disorders and depression in shift workers in comparison with day workers. Sleep 2011;34 Abstr Suppl:A165.

16. Lee A, Myung SK, Cho JJ, Jung YJ, Yoon JL, Kim MY. Night shift work and risk of depression: meta-analysis of observational studies. J Korean Med Sci 2017;32(7):1091-6.
    PUBMED | CROSSREF

17. Levis B, Benedetti A, Thombs BDDEPRESsion Screening Data (DEPRESSD) Collaboration. Accuracy of Patient Health Questionnaire-9 (PHQ-9) for screening to detect major depression: individual participant data meta-analysis. BMJ 2019;365:l1476.
    PUBMED | CROSSREF

18. Øyane NM, Pallesen S, Moen BE, Akerstedt T, Bjorvatn B. Associations between night work and anxiety, depression, insomnia, sleepiness and fatigue in a sample of Norwegian nurses. PLoS One 2013;8(8):e70228.
    PUBMED | CROSSREF

19. Meyer-Lindenberg A. Neural connectivity as an intermediate phenotype: brain networks under genetic control. Hum Brain Mapp 2009;30(7):1938-46.
    PUBMED | CROSSREF

20. Hall BS, Moda RN, Liston C. Glucocorticoid mechanisms of functional connectivity changes in stress-related neuropsychiatric disorders. Neurobiol Stress 2015;1:174-83.
    PUBMED | CROSSREF

21. Gherardi-Donato EC, Cardoso L, Teixeira CAB, Pereira Sde S, Reisdorfer E. Association between depression and work stress in nursing professionals with technical education level. Rev Lat Am Enfermagem 2015;23(4):733-40.
    PUBMED | **CROSSREF**

22. Kim GE, Jo MW, Shin YW. Increased prevalence of depression in South Korea from 2002 to 2013. Sci Rep 2020;10(1):16979.
    PUBMED | **CROSSREF**

23. Wright A, Harris MG, Wiggers JH, Jorm AF, Cotton SM, Harrigan SM, et al. Recognition of depression and psychosis by young Australians and their beliefs about treatment. Med J Aust 2005;183(1):18-23.
    PUBMED | **CROSSREF**

24. Vera M, Alegría M, Freeman DH Jr, Robles R, Pescosolido B, Peña M. Help seeking for mental health care among poor Puerto Ricans: problem recognition, service use, and type of provider. Med Care 1998;36(7):1047-56.
    PUBMED | **CROSSREF**