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\*Correspondence:

Kyung-Jae Lee

Department of Occupational and  
Environmental Medicine, Soonchunhyang  
University Hospital, 59 Daesagwan-ro,  
Yongsan-gu, Seoul 04401, Korea.  
Email: leekj@schmc.ac.kr

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cited.

ORCID iDs

Yoon-Soo Jang   
<https://orcid.org/0000-0002-9686-2013>  
Jae-Han Lee   
<https://orcid.org/0000-0002-6176-9142>  
Na-Rae Lee   
<https://orcid.org/0000-0002-2679-9813>  
Dong-Woo Kim   
<https://orcid.org/0009-0006-2976-4372>  
June-Hee Lee   
<https://orcid.org/0000-0002-7682-6023>  
Kyung-Jae Lee   
<https://orcid.org/0000-0001-5759-2367>

# Association between receiving work communications outside of work hours via telecommunication devices and work-related headaches and eyestrain: a cross-sectional analysis of the 6th Korean Working Conditions Survey

Yoon-Soo Jang , Jae-Han Lee , Na-Rae Lee , Dong-Woo Kim , June-Hee Lee ,  
and Kyung-Jae Lee \*

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

## ABSTRACT

**Background:** The rise in telecommuting or non-face-to-face work owing to the coronavirus disease 2019 pandemic has fueled conversations regarding the “right to disconnect.” Although evidence suggests that receiving work-related communications through telecommunication devices outside of work hours may lead to various symptoms and illnesses, limited research has been undertaken on these symptoms. This study therefore aims to investigate the correlation between receiving work communications through telecommunication devices after work hours and the occurrence of work-related headaches and eyestrain in full-time, non-shift white-collar workers.

**Methods:** This study used data from the 6th Korean Working Conditions Survey. The frequency of using telecommunication devices for work purposes outside of working hours was divided into five categories: “Every day,” “Several times a week,” “Several times a month,” “Rarely,” and “Never.” Work-related headaches and eyestrain were categorized based on a “yes” or “no” response to the survey questions. Descriptive statistics,  $\chi^2$  tests, and multiple logistic regression analyses were performed using SPSS 27.0.

**Results:** After adjusting for sex, age, income level, education, occupation, workplace size, work hours, and sleep disorders, the odds ratio (OR) of work-related headaches and eyestrain based on frequency of telecommunication device usage were as follows: “rarely” (OR: 1.292; 95% confidence interval [CI]: 1.111–1.503), “several times a month” (OR: 1.551; 95% CI: 1.249–1.926), “several times a week” (OR: 1.474; 95% CI: 1.217–1.784), and “every day” (OR: 1.548; 95% CI: 1.321–1.813).

**Conclusions:** Employees who use telecommunication devices for work after regular hours are more susceptible to experiencing work-related headaches and eyestrain compared to those who do not. However, there is a dearth of research examining the physical and mental health impacts of using telecommunication devices for after-hours work. Furthermore, the existing

### Abbreviations

CI: confidence interval; COVID-19: coronavirus disease 2019; ICTs: information and communication technologies; KWCS: Korean Working Conditions Survey; OR: odds ratio.

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### Competing interests

The authors declare that they have no competing interests.

### Author Contributions

Conceptualization: Jang YS. Data curation: Jang YS, Lee JH<sup>1</sup>, Lee NR, Kim DW. Formal analysis: Jang YS. Supervision: Lee JH<sup>2</sup>, Lee KJ. Writing - original draft: Jang YS. Writing - review & editing: Jang YS, Lee JH<sup>2</sup>, Lee KJ. Lee JH<sup>1</sup>, Jae-Han Lee; Lee JH<sup>2</sup>, June-Hee Lee.

preventative measures in Korea are insufficient. Consequently, it is imperative to develop effective measures and conduct additional research to address this issue.

**Keywords:** Headache; Eyestrain; Smartphone; Occupational stress

## BACKGROUND

According to a 2015 study by the Korea Institute of Labor Research, 70.3% of workers used smart devices to perform work-related tasks after hours or on holidays.<sup>1</sup> A 2021 survey by the Gyeonggi Research Institute found that 87.8% of 500 wage earners received work instructions after hours, most frequently through private messengers such as KakaoTalk. With coronavirus disease 2019 (COVID-19) leading to an increase in non-face-to-face work, also called telecommuting, discussions about the “right to disconnect” are ongoing both domestically and internationally.<sup>2</sup> In 2015, Bruno Mettling proposed the right of workers to block contact with or access to company businesses at certain times.<sup>3</sup> French Labor Minister Myriam El Khomri incorporated this into an amendment to the Labor Code, which has been in effect since 2017.<sup>3</sup> Countries such as Slovakia, Italy, and the Philippines have also incorporated the right to disconnect into their labor laws, and a related legislation has been under discussion in South Korea since 2016 but has not been implemented.<sup>1,3</sup>

As early as the 1980s, the concept of “technostress”—the inability to adapt to and cope with the use of rapidly developing digital products—was discussed. Even in the modern world, the development of information and communication technologies (ICTs) such as smartphones and tablet PCs can lead to technostress through work overload and feelings of work constraint.<sup>4,5</sup> Technostress can also be experienced in the form of extended work hours. The development of ICTs allows workers to be constantly connected and exposed to their work outside of working hours through, for example, email.<sup>6</sup> This increases feelings of work obligation and negatively affects job satisfaction.<sup>7</sup> Being constantly connected to work outside of working hours can also blur the boundaries between work and home, leading to work-family conflict.<sup>8</sup>

While there is limited research on health issues associated with being contacted outside of regular working hours for work-related matters, a study of European workers found a higher risk of reporting one or more health problems in those contacted sometimes or often than never.<sup>9</sup> Several studies have shown that staying connected to work after hours, including smartphone use, increases job stress.<sup>10,12</sup> The U.S. National Institute for Occupational Safety and Health defines job stress as “a harmful physical and emotional response that occurs when job demands are inconsistent with a worker’s abilities, resources, or desires (needs).” Job stress has been shown to have adverse effects on individual health, including headaches and insomnia, and high-stress groups with high job demands and low job control have been associated with migraines among both men and women.<sup>13</sup> Other studies have shown that higher quantitative demands and role conflicts are associated with headache severity.<sup>14</sup> Since quantitative work overload has been found to be strongly related to work stress in small and medium-size companies, and asking employees to work outside of normal working hours is one way to solve work overload, it is also necessary to consider company size.<sup>15,16</sup>

Various occupational environmental factors, such as metals, organic solvents, and noise, have been reported to be associated with headaches, and more recently, headache and eyestrain

symptoms have been linked to improper work posture and visual display terminal use.<sup>17</sup> Headaches are a common symptom among workers and can adversely affect their health and reduce productivity.<sup>18</sup> All-cause headache is associated with an increased risk of dry eye, according to a systematic review and meta-analysis.<sup>19</sup> Headache intensity has also been linked to depression, anxiety, metabolic syndrome, diabetes, and low high-density lipoprotein levels.<sup>20</sup> Headaches are not a single symptom but can have multiple physical manifestations.

Receiving work communication via telecommunication devices after work hours is potentially associated with a variety of symptoms and illnesses. However, research on these symptoms has been limited. In addition, white-collar workers are thought to be a group that is vulnerable to after-hours communication, as they are frequently instructed to work using work communication devices such as email and internal messengers due to the nature of their jobs, but there is a lack of research on after-hours communication that focuses only on white-collar workers. Therefore, this study aims to examine the association between receiving work tasks after hours via communication technology and work-related headaches and eyestrain in full-time, non-shift white-collar workers.

## METHODS

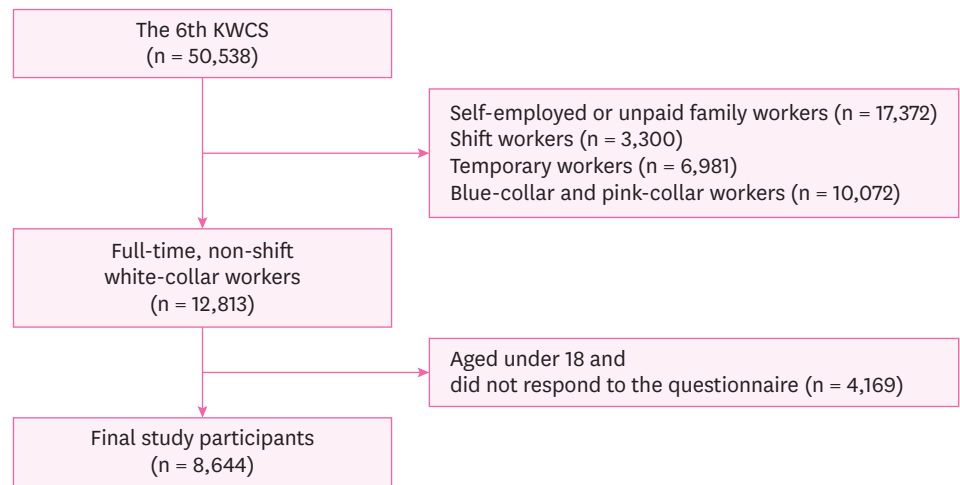
### Data sources and study population

This study used data from the 6th Korean Working Conditions Survey (KWCS) conducted in 2020. The KWCS is conducted by the Korea Occupational Safety and Health Agency every 3 years to establish policies to improve working conditions. In the 6th KWCS, on-site surveys were suspended owing to the impact of COVID-19, and methods such as non-face-to-face online surveys were used instead.

In total, 50,538 workers aged 15 years and older participated in the 6th KWCS. Of these, 17,372 were self-employed and unpaid family workers, 3,300 were shift workers, 6,981 were temporary and day laborers, and 10,072 were blue-collar (technicians, skilled agricultural and fishery workers, craft and related trade workers, plant and machine operators, elementary workers, and military personnel) and pink-collar workers (service and sales workers). We also excluded 4,169 workers under the age of 18 and those who answered “don’t know/no response” or “refused” to questions about the study’s main variables and covariates, leaving us with a final sample of 8,644 full-time, non-shift white-collar workers (Fig. 1).

### Measurement

The frequency of using telecommunication devices for work purposes outside of working hours was divided into five categories based on responses to the following KWCS question: “How often did you use a telecommunication device for work during your free time outside of regular working hours last month?”: “Every day,” “Several times a week,” “Several times a month,” “Rarely,” and “Never.” Communication types include emails, telephonic conversation, video conferencing, texting, and social media. Work-related headaches and eyestrain were categorized based on a “yes” or “no” response to the following questions: “In the past 12 months, have you had any of the following health problems?”; if yes, then “Did it happen because of your job?”. Those who answered “yes” to these consecutive questions were considered to have work-related headaches and eyestrain. Demographic variables included sex, age (< 30, 30–39, 40–49, 50–59, and ≥ 60 years), education (less than a high school diploma and more than a college degree), income level (1st, 2nd, 3rd, and 4th quintile),



**Fig. 1.** Flowchart of participant selection.  
KWCS: Korean Working Conditions Survey.

occupation (managers, professionals, and office workers), work hours (< 40 hours, 40–52 hours, and > 52 hours), workplace size (small [1–49 workers], medium [50–299 workers], and large [ $\geq 300$  workers]),<sup>8</sup> sleep disorder status, and use of electronic devices such as computers during work hours. For sleep disorder status, the Minimal Insomnia Symptom Scale was utilized to assess respondents' answers to the items “difficulty in initiating sleep,” “difficulty in maintaining sleep,” and “non-restorative sleep,” with a score of 0 for “never,” 1 for “less often,” 2 for “several times a month,” 3 for “several times a week,” and 4 for “daily.” If the sum of the three items was 6 or more, the respondent was considered to have a sleep disorder.<sup>21,22</sup> The amount of time spent on computers and other electronic devices during work hours was categorized into three groups: less than half of the time, more than half but less than 3-quarters of the time, and more than 3-quarters of the time.<sup>23</sup>

### Statistical analysis

A frequency analysis was conducted to assess demographic variables, occupations, working hours, workplace size, sleep disorders, use of computers and other electronic devices during working hours, and frequency of using telecommunication devices after hours. A  $\chi^2$  test was conducted to determine the frequency of work-related headaches and eye fatigue according to the frequency of communication device use after hours. Odds ratios (ORs) and 95% confidence intervals (CIs) of work-related headaches and eyestrain according to the frequency of telecommunication device use after hours were calculated using multiple logistic regression. Model I adjusts for the demographic variables of sex, age, income level, and education. In addition to demographic variables, Model II adjusts for occupational factors considered to affect work-related headaches and eyestrain, such as occupation, working hours, workplace size, use of electronic devices during work hours, and sleep disorders. All statistical analyses were performed using SPSS 27.0 (IBM Corp., Armonk, NY, USA).

### Ethics statement

This study used only de-identified database disclosed to the public without personal identification information; therefore, neither approval by the Institutional Review Board nor obtainment of the informed consent is necessary.

## RESULTS

**Table 1** presents the general characteristics of the 8,644 participants. In terms of demographic variables, women (53.5%) outnumbered men (46.5%), and most workers had a college degree or higher (88.6%). In terms of workplace size, the “small” group was the most common (57.7%), and 60.9% of workers used computers and other electronic devices for more than 3-quarters of their working hours. While 29.8% of workers had never used telecommunication devices to get work done outside of work hours (“Never”), 21.4% reported using them every day (“Everyday”).

**Table 2** shows the prevalence of work-related headaches and eyestrain according to demographic variables, other covariates, and the frequency of using telecommunication

**Table 1.** General characteristics of the study population

Characteristics	Total (n = 8,644)
<b>Sex</b>	
Male	4,017 (46.5)
Female	4,627 (53.5)
<b>Age</b>	
< 30	1,138 (13.2)
30–39	2,899 (33.5)
40–49	2,733 (31.6)
50–59	1,544 (18.0)
≥ 60	320 (3.7)
<b>Education</b>	
≤ High school	989 (11.4)
≥ College	7,655 (88.6)
<b>Income</b>	
1Q-Low	2,293 (26.5)
2Q	1,837 (21.3)
3Q	2,154 (24.9)
4Q-High	2,360 (27.3)
<b>Occupation</b>	
Managers	123 (1.4)
Professionals	3,877 (44.9)
Office workers	4,644 (53.7)
<b>Weekly working hours</b>	
< 40 hours	464 (5.4)
40–52 hours	7,987 (92.4)
> 52 hours	193 (2.2)
<b>Size of workplace</b>	
Small (1–49 workers)	4,988 (57.7)
Medium (50–299 workers)	1,860 (21.5)
Large (≥ 300 workers)	1,796 (20.8)
<b>Electronic device use during work hours</b>	
< 1/2 of the time	1,578 (18.3)
1/2–3/4 of the time	1,804 (20.9)
> 3/4 of the time	5,262 (60.9)
<b>Sleep disorder</b>	
No	8,014 (92.7)
Yes	630 (7.3)
<b>After-hours work on communication devices</b>	
Never	2,572 (29.8)
Rarely	2,553 (29.5)
Several times per month	665 (7.7)
Several times per week	1,001 (11.6)
Everyday	1,853 (21.4)

Values are presented as number (%).

**Table 2.** The proportion of work-related headaches and eyestrain with respect to the demographic variables, other covariates, and the frequency of using telecommunication devices after hours

Characteristics	Work-related headaches and eyestrain		p-value <sup>a</sup>
	No	Yes	
Sex			0.178
Male	3,210 (79.9)	807 (20.1)	
Female	3,643 (78.7)	984 (21.3)	
Age			< 0.001
< 30	921 (80.9)	217 (19.1)	
30–39	2,274 (78.4)	625 (21.6)	
40–49	2,114 (77.4)	619 (22.6)	
50–59	1,270 (81.7)	284 (18.3)	
≥ 60	274 (85.6)	46 (14.4)	
Education			< 0.001
≤ High school	834 (84.3)	155 (15.7)	
≥ College	6,019 (78.6)	1,636 (21.4)	
Income			< 0.001
1Q-Low	1,897 (82.7)	396 (17.3)	
2Q	1,443 (78.6)	394 (21.4)	
3Q	1,721 (79.9)	433 (20.1)	
4Q-High	1,792 (75.9)	568 (24.1)	
Occupation			< 0.001
Managers	97 (78.9)	26 (21.1)	
Professionals	3,001 (77.4)	876 (22.6)	
Office workers	3,775 (80.9)	889 (19.1)	
Weekly working hours			0.211
< 40 hours	381 (82.1)	83 (17.9)	
40–52 hours	6,324 (79.2)	1,663 (20.8)	
> 52 hours	148 (76.7)	45 (23.3)	
Size of workplace			< 0.001
Small (1–49 workers)	4,130 (82.8)	858 (17.2)	
Medium (50–299 workers)	1,411 (75.9)	449 (24.1)	
Large (≥ 300 workers)	1,312 (73.1)	484 (26.9)	
Electronic device use during work hours			< 0.001
< 1/2 of the time	1,397 (88.5)	181 (11.5)	
1/2–3/4 of the time	1,530 (84.8)	274 (15.2)	
> 3/4 of the time	3,926 (74.6)	1,336 (25.4)	
Sleep disorder			< 0.001
No	6,576 (82.1)	1,438 (17.9)	
Yes	277 (44.0)	353 (56.0)	
After-hours work on communication devices			< 0.001
Never	2,179 (84.7)	393 (15.3)	
Rarely	2,033 (74.6)	520 (20.4)	
Several times per month	489 (73.5)	176 (26.5)	
Several times per week	760 (75.9)	241 (24.1)	
Everyday	1,392 (75.1)	461 (24.9)	

Values are presented as number (%).

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

devices after hours. Work-related headache and eyestrain rates were higher among those with a college degree or higher (21.4%) than among those with a high school diploma or less (15.7%) and higher among those in the 4th income quartile (24.1%) than those in the 1st income quartile (17.3%). The rate of work-related headaches and eyestrain was 25.4% among workers who spent more than 3-quarters of their time using electronic devices such as computers during the workday, which was higher than those who spent half to 3-quarters (15.2%) and less than half (11.5%). Regarding workplace size, the rates were 17.2% for small, 24.1% for medium, and 26.9% for large workplaces. Workers with sleep disorders (56.0%) were three times more likely to experience work-related headaches and eyestrain than those without sleep disorders (17.9%). The prevalence of work-related headaches and eyestrain

**Table 3.** Multiple logistic regression analysis of work-related headaches and eyestrain according to frequency of after-hours work on telecommunication devices

Work-related headaches and eyestrain	OR	95% CI
Crude		
Never	Reference	
Rarely	1.418	1.228–1.638
Several times per month	1.996	1.629–2.445
Several times per week	1.758	1.468–2.106
Everyday	1.836	1.580–2.134
Model I <sup>a</sup>		
Never	Reference	
Rarely	1.367	1.182–1.581
Several times per month	1.908	1.555–2.342
Several times per week	1.691	1.410–2.028
Everyday	1.783	1.532–2.075
Model II <sup>b</sup>		
Never	Reference	
Rarely	1.292	1.111–1.503
Several times per month	1.551	1.249–1.926
Several times per week	1.474	1.217–1.784
Everyday	1.548	1.321–1.813

OR: odds ratio; CI: confidence interval.

<sup>a</sup>Adjusted by sociodemographic characteristics (sex, age, education, income).

<sup>b</sup>Adjusted by sociodemographic characteristics and other characteristics (occupation, weekly working hours, workplace size, electronic device use during work hours, sleep disorder).

according to the frequency of using communication devices after work hours was 15.3% for “never,” 20.4% for “rarely,” 26.5% for “several times a month,” 24.1% for “several times a week,” and 24.9% for “every day.”

**Table 3** shows the association between the frequency of after-hours work on telecommunication devices and work-related headaches and eyestrain, analyzed using multiple logistic regression. After adjusting for sex, age, income level, education, workplace size, work hours, and sleep disorders, the OR were as follows: “rarely” (OR: 1.292; 95% CI: 1.111–1.503), “several times a month” (OR: 1.551; 95% CI: 1.249–1.926), “several times a week” (OR: 1.474; 95% CI: 1.217–1.784), and “daily” (OR: 1.548; 95% CI: 1.321–1.813). All results were statistically significant ( $p < 0.001$ ).

## DISCUSSION

The current study aimed to determine the frequency of after-hours telecommunication device use and its association with work-related headaches and eyestrain in full-time, non-shift white-collar workers. The three main findings of the study are as follows. First, workers who reported infrequent use of communication devices outside of work hours were positively associated with work-related headaches and eyestrain, with an OR of 1.292, although this was lower than for “several times a month,” “several times a week,” and “daily.” From this, we can infer that workers who have a history of using telecommunication devices outside of work hours, even on rare occasions, are more likely to experience work-related headaches and eyestrain than those who do not.

Second, the OR for work-related headache and eyestrain symptoms in workers who used communication devices outside of work hours several times a week and every day were 1.474 and 1.548, respectively, compared with 1.292 for workers who used communication devices

outside of work hours infrequently. Daily hassles, such as deadlines, are associated with daily headaches. Furthermore, it is thought that chronic stress exposure may be linked to central sensitization, which in turn may lead to chronicity of headaches.<sup>24,25</sup> Frequent after-hours work-related contact increases vulnerability to stress, suggesting its possible association with chronic headache.

Third, the OR of work-related headache and eyestrain symptoms for workers who had after-hours contact with communication devices several times a month was 1.551, compared to 1.474 and 1.548, respectively, for workers who had after-hours contact several times a week and daily. Receiving work-related after-hours contact several times a month, rather than daily, may increase susceptibility to headaches owing to the coincidence or discontinuity of stress.<sup>26</sup> Additionally, the occasional after-hours work-related contact can be explained in terms of work unpredictability, defined as the inability of workers to anticipate the tasks to be performed, including time requirements and methods.<sup>27</sup> Moreover, sustained stress reaction from work unpredictability can adversely affect workers' evening wellbeing.<sup>27,28</sup> Taken together, these findings suggest that the fact of being contacted is more important than the frequency of being contacted for after-hours work purposes.

Using telecommunication devices for after-hours work is thought to cause work-related rumination. Work-related rumination refers to people's tendencies to think about work-related issues and events. Cropley and Zijlstra<sup>29</sup> proposed the concepts of affective rumination and problem-solving pondering to encompass both the positive and negative aspects of work-related rumination. Affective rumination is related to a cascade of negative emotional reactions that occur when thinking consistently about a problem.<sup>29</sup> In a study of Korean hotel and duty-free shop workers, after-hours work contact was found to have a moderating effect on emotional rumination, which in turn had a moderating effect on emotional exhaustion.<sup>30</sup> Work-related rumination is also associated with increased cortisol secretion and has been associated with poor sleep quality.<sup>31-33</sup> However, there is limited research on the association between work-related rumination and headaches and eyestrain, and thus, more research is needed on the association between work-related rumination and headaches and eyestrain, as well as the use of communication devices outside of work hours.

The strengths of this study are as follows. This study used national survey data on working conditions for comparisons within a large group of workers. The study was conducted with a homogeneous group of full-time, non-shift white-collar workers. Future studies of shift workers or service and production workers could compare the effects of the frequency of after-hours use of communication devices. This study also examined the specific symptoms of headaches and eyestrain, whereas previous discussions on the right to disconnect were relatively limited to legal and social science research. We hope that future research will expand the discussion to include links to diseases such as tension-type headaches and migraines.

The limitations of this study are as follows. First, this was a cross-sectional study, which limited the interpretation of the temporal causal relationship between the frequency of communication device use after work hours and work-related headache and eyestrain symptoms. However, existing studies show that using communication devices after work hours can cause job stress, which in turn can cause physical and mental health symptoms such as depression, anxiety, and headaches. Therefore, further studies are needed to prove the causal relationship between the two. Research is also needed on whether job stress is a mediator between work-related headaches and eyestrain and after-work hours use of



communication devices. Second, individual non-work smartphone use, such as watching videos and playing games, may also contribute to headaches and eyestrain<sup>34,35</sup>; however, it was not possible to adjust for these effects due to the absence of a question identifying this information. The third limitation of the study design was that the duration of the headache and eyestrain symptoms was 12 months, whereas the recall period for the questionnaire was one month to assess the frequency of using communication devices after work hours; this may limit the interpretation of the results. A question on the frequency of work using communication devices after work hours was introduced for the first time in the 6th KWCS. It would be helpful to conduct a comparative study by referring to the Korean and European working environment surveys that are regularly conducted in the future.

With the continued advances in ICTs and the impact of the COVID-19 pandemic, the right to work and disconnect from telecommunication devices is likely to be increasingly discussed and legislated. However, there is a lack of medical research on this issue, including the link between symptoms and diseases. Continued research on the health effects of workers' use of telecommunication devices to handle work outside of working hours will be helpful in preparing workplace-level and national countermeasures.

## CONCLUSIONS

Workers who use telecommunication devices for after-hours work are more likely to experience work-related headaches and eyestrain than those who do not. However, there is limited research on the physical and mental disorders caused by using telecommunication devices to work after hours. Moreover, the measures to prevent such disorders are insufficient in the Korean context. Therefore, it is necessary to establish appropriate measures and conduct further research.

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