Beyond working hours: the association between long working hours, the use of work-related communication devices outside regular working hours, and anxiety symptoms

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Abstract

Objectives: The present study aimed to identify and compare the associations between long working hours and use of work-related communication devices outside regular working hours and anxiety symptoms, thereby providing insight into redefining working hours.
Methods: Based on the cross-sectional data from the sixth Korean Working Conditions Survey (KWCS), specifically the responses from 46 055 workers, the use of work-related communication devices outside of regular working hours, long working hours, and anxiety symptoms were assessed. To investigate the associations between using work-related communication devices outside regular working hours or long working hours with anxiety symptoms, odds ratios (ORs) and 95% CIs were calculated using multiple logistic regression models.
Results: Among 46 055 participants, 25 659 (55.7%) used work-related communication devices outside working hours, 8145 (17.7%) worked long hours, and 2664 (5.8%) experienced anxiety symptoms. Compared with the reference group, those who used work-related communication devices outside regular working hours without working long hours, had higher OR of anxiety symptoms (OR: 2.18; 95% CI, 1.97-2.41) than those who worked long hours without using work-related communication devices during off-hours (OR: 1.32; 95% CI, 1.09-1.59). Furthermore, the group that both worked long hours and used work-related communication devices outside working hours exhibited the highest OR of anxiety symptoms (OR: 2.57; 95% CI, 2.24-2.97).
Conclusions: Using work-related communication devices outside regular working hours is associated with a higher risk of anxiety symptoms compared with long working hours. This result suggests that using work-related devices outside regular working hours, in addition to regular work time, should be considered when redefining working hours.

> **Key points**
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> **What is already known on this topic**—Long working hours and the use of work-related communication devices outside of regular working hours are both associated with negative effects on an employee's mental health, but there is a lack of research comparing them.
> **What this study adds**—Both the use of work-related communication devices outside regular working hours and extended working hours were associated with anxiety symptoms. Notably, the use of work-related communication devices outside regular working hours was associated with greater risk compared with long working hours.
> **How this study might affect research**, practice, or policy—This study suggests considering the use of work-related communication devices outside regular working hours when redefining working hours.

Introduction

The proliferation of communication devices and advancements in communication technologies have brought about significant changes in various aspects of our daily lives, including the workplace.[1] These devices enable communication to occur non-face-to-face, allowing for quicker and more convenient exchange of business content within the workplace. This shift has resulted in reduced time and space constraints, leading to improved productivity and efficiency.[1,2]

However, this increased connectivity does not always benefit the workplace,[3] and when communication devices are used beyond working hours, workers can experience persistent psychological attachment to their work. Consequently, workers may

have to extend their work hours or experience a psychological burden and excessive work engagement. Furthermore, the possibility of unpredictable new tasks may induce anxiety, negatively impacting their health.[4–6] Given the rising opportunities for use of work-related communication devices outside of working hours, it is crucial to discuss whether unofficial work-related contacts and the subsequent time spent on work outside of regular hours should be included in defining working hours.

Various researches have been conducted on the mental health effects of long working hours. Working long hours is associated with increased levels of anxiety and depression, with a dose-response relationship[7]; another study also confirmed that workers engaged in long working hours exhibit worse mental health conditions.[8] A significant association exists between long work hours and sleep problems among male public school teachers.[9] However, these studies do not consider the use of work-related communication devices outside of regular working hours, focusing solely on working hours.

Several other studies have confirmed the adverse effects of using work-related communication devices outside regular working hours on workers' health and well-being. Such use has been associated with negative impacts on mental health and occupational burnout.[10–12] It also hampers detachment from work, impeding physical and mental recovery.[3] It has also been found to disrupt sleep patterns[13] and cause work–family conflicts.[12,14] However, previous studies were constrained by small sample sizes or focused on a limited number of occupational groups. Moreover, as the use of work communication devices after working hours can be considered an extension of work, it is necessary to analyze and compare the implication of long working hours and the use of work communication devices outside of working hours. However, there is a lack of research on this topic, necessitating additional research into the relationship between the use of work-related communication devices outside working hours and its related mental health phenomena.

This study aimed to identify the association between long working hours and the use of work-related communication devices outside regular working hours with anxiety symptoms. Moreover, by comparing the respective association of these variables with anxiety symptoms, we provide insights into the redefinition of working hours. Additionally, to ensure generalizability of our findings at a national level, we utilized a representative sample of Korean workers and analyzed a sufficient number of subjects to obtain reliable results.

Methods
Study participants
This study used cross-sectional data from the sixth Korean Working Conditions Survey (KWCS), which is conducted every 3 years to gather fundamental data on various employment and labor environments and establish policies related to industrial accident safety and health. In the sixth KWCS, specific survey areas, such as remote islands, mountainous regions, tourist hotels, and foreigner residences, were excluded from consideration. A total of 5000 sample survey areas were then systematically selected from the remaining 366 846 survey areas in South Korea, with stratification across 17 provinces and administrative regions. For each survey area, household rosters were reviewed, and a systematic sampling was employed to select 10 households. The survey targeted individuals aged 15 and above who had engaged in at least 1 hour of work in the preceding week for income. In cases where a household comprised 2 or more working individuals, the survey participants were randomly chosen.

The survey was conducted between October 2020 and April 2021 through individual interviews with investigators and online surveys. A total of 50 538 workers aged 15 years or older participated in the sixth KWCS. Out of the final 50 538 participants' data, 30 561 were conducted through online survey and Tablet PC Assisted Personal Interviewing (TAPI). Questionnaires were used for 19 977 surveys, and these were conducted through one-on-one visitation surveys by professional interviewers. All survey data underwent a validation process. Initially, regional supervisors conducted verification, including assessing participant eligibility, and confirming household visit records. Subsequently, a secondary validation process was carried out to ensure logical consistency among survey items, identify anomalies in response ranges, and address non-responses. Surveys conducted via TAPI were automatically validated within the system, whereas only self-administered surveys underwent a secondary validation process conducted by professional editors. In cases where issues were identified with a survey, follow-up investigations involving telephone interviews were conducted. In intractable cases, those survey data were discarded.

Initially, among the 50 538 respondents who participated in the sixth KWCS, 48 784 workers are selected by excluding those under the age of 20 and unpaid family workers. After excluding respondents with incomplete answers to health-related variables and covariates, the final analysis included 46 055 participants (Figure 1).

Main variables
Anxiety symptoms
The presence of anxiety symptoms was determined based on the responses to the question of "Have you had anxiety over the last 12 months?" Participants could answer "yes" or "no."

Use of work-related communication devices outside of regular working hours
Participants were asked about the frequency of using work-related communication devices outside of regular working hours. The question was rated on a 5-point scale: "In the last month, in your free time, how often have you used communication tools for work? Communication tools include emails, phone and video conferencing, text messaging, social media, and other apps." Responses of "daily," "several times a week," "several times a month," and "less often" were classified as use group, whereas "never" was classified as unuse group.

Working hours
Participants were asked about their actual working hours at their main job workplace. Weekly working hours were used as reported, whereas monthly working hours were converted to weekly by dividing them by 4. Long working hours were defined as "working more than 52 hours/week" or "working 52 hours/week or less" based on the maximum limit of 52 h/wk stipulated in the Korean Labor Standards Act.

Covariates
The potential confounding factors included gender, age, educational level, household monthly income, occupation type, and self-reported health status. Age was categorized as 20-29, 30-39, 40-49, 50-59, and above 60. Educational level was categorized as high-school graduate or below and college graduate or higher. Household monthly income was classified as below
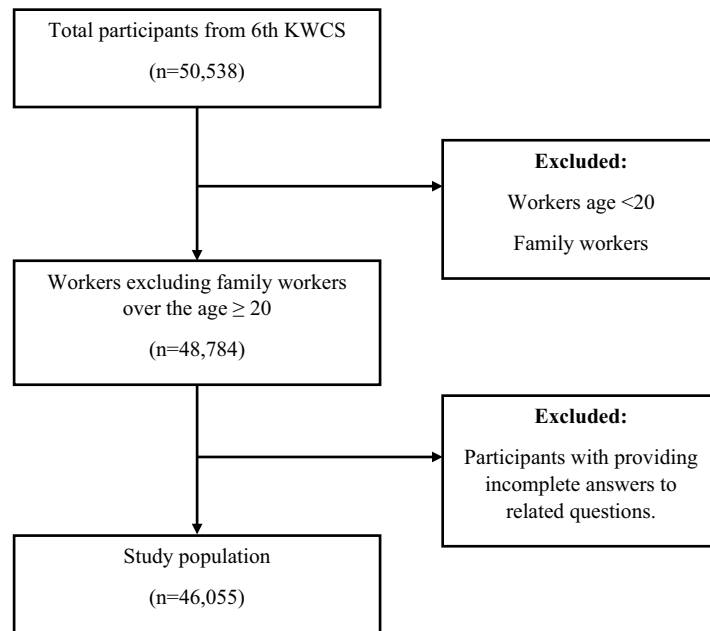
Figure 1. The process of selecting the study population.

2 000 000 (1546 USD, currency exchange rate: 1294 KRW/USD) KRW, 2 000 000-3 000 000 KRW (1546-2318 USD), 3 000 000-4 000 000 KRW (2318-3091 USD), and above 4 000 000 KRW (3091 USD), based on the average monthly income. The occupation types were classified based on the Korean Standard Classification of Occupations. The current study used a modified occupational classification with 3 categories based on a previous study[15]: white-collar (managers, professionals, technicians, and clerical support workers), pink- and green-collar (services, sales, agricultural, forestry, and fishery workers), and blue-collar workers (machine operators, assemblers, and unskilled elementary workers). Self-reported health status was determined by the question, "How is your health in general?" Participants who answered "Very good," "Good," or "Fair" were classified as "Not bad," whereas those who answered "Bad" or "Very Bad" were classified as "Bad."

The above-mentioned confounding variables were selected based on other prior research. Anxiety disorders are known to be more prevalent in women than in men.[16,17] It is generally accepted that prevalence decreases with increasing age, although it varies according to the sociocultural environment.[16] Furthermore, mental diseases, including anxiety disorders, are related to physical health conditions and increase when general physical health conditions are poor.[18,19] Occupational type has been found to be related to both physical and mental health problems.[20] The association between socioeconomic level and anxiety disorder has been addressed in other articles.[21] Accordingly, these variables were determined to be the covariates in this study.

Statistical analysis

Chi-square analysis was used to confirm the differences in baseline characteristics according to the use of work-related communication devices outside regular working hours. To calculate the odds ratios (ORs) and 95% CIs for anxiety symptoms with respect to the use of work-related communication devices outside working hours or long working hours, multiple logistic regression analysis was conducted, which was adjusted for sex, age, education level, household income, and self-reported health status. All statistical analyses were performed using SAS (version 9.4; SAS

Institute, Cary, NC, USA), and the significance level was defined as $P < .05$.

Results

Table 1 presents the general characteristics of the participants according to their anxiety symptoms. The study included 46 055 respondents, consisting of 22 152 males and 23 903 females. The group exhibiting anxiety symptoms comprised 2664 participants, whereas the group without such symptoms comprised 43 391 participants. Significant differences were observed in age, monthly household income, self-reported health conditions, and weekly working hours.

Compared with the group without anxiety symptoms, the group with anxiety symptoms had a higher proportion of individuals aged 30-59, higher income levels, and reported "bad" health conditions. Additionally, the group with anxiety symptoms had a higher proportion of workers who worked long hours and used work-related communication devices outside of their regular working hours.

A multiple logistic regression analysis was performed to examine the relationship between anxiety symptoms and the use of work-related communication devices outside regular working hours (Table 2). The OR was 2.13 (95% CI, 1.95-2.33) for the entire group of workers, 2.23 (95% CI, 2.01-2.64) for males and 1.99 (95% CI, 1.77-2.25) for females.

To further investigate the association of working hours or work-related communication device use during non-working hours on anxiety symptoms, a multiple logistic regression analysis was conducted by dividing the participants into 4 groups based on their working hours and use of communication devices outside regular working hours (Table 3).

In the total subjects, the OR for the group that worked less than 52 h/wk but used work-related communication devices outside of working hours was 2.18 (95% CI, 1.97-2.41). In the male subgroup that OR was 2.42 (95% CI, 2.06-2.83), in the female subgroup it was 2.00 (95% CI, 1.76-2.29). For the group that worked more than 52 h/wk but did not use work-related communication devices outside of working hours, the OR was 1.32 (95% CI, 1.09-1.59)

Table 1. Baseline characteristics of study population ($n = 46\,055$).[a]

| Characteristics | Total | Presence of anxiety symptoms | | P value[b] |
		Present ($n = 2664$)	Not present ($n = 43\,391$)	
Gender				.1069
Male	22 152 (48.1)	1241 (46.6)	20 911 (48.2)	
Female	23 903 (51.9)	1423 (53.4)	22 480 (51.8)	
Age (years)				.0274
20-29	4374 (9.5)	171 (6.4)	4203 (9.7)	
30-39	8086 (17.6)	476 (17.9)	7610 (17.5)	
40-49	10 230 (22.2)	650 (24.4)	9580 (22.1)	
50-59	11 419 (24.8)	704 (26.4)	10 715 (24.7)	
≥60	11 946 (25.9)	663 (24.9)	11 283 (26.0)	
Educational level				.0528
High-school graduate or below	24 435 (53.1)	1365 (51.2)	23 070 (53.2)	
College graduate or higher	21 620 (46.9)	1299 (48.8)	20 321 (46.8)	
Monthly household income (million KRW)				.0328
<2	15 038 (32.7)	841 (31.6)	14 197 (32.7)	
2-3	14 452 (31.4)	819 (30.7)	13 633 (31.4)	
3-4	9364 (20.3)	549 (20.6)	8815 (20.3)	
>4	7201 (15.6)	455 (17.1)	6746 (15.6)	
Occupation type				.1837
White-collar	19 506 (42.4)	1158 (43.5)	18 348 (42.3)	
Pink-/green-collar	16 914 (36.7)	970 (36.4)	15 944 (36.7)	
Blue-collar	9635 (20.9)	536 (20.1)	9099 (21.0)	
Self-reported health condition				<.0001
Not bad	43 533 (94.5)	2170 (81.5)	41 363 (95.3)	
Bad	2522 (5.5)	494 (18.5)	2028 (4.7)	
Weekly working hours				<.0001
≤52	37 910 (82.3)	2113 (79.3)	35 797 (82.5)	
>52	8145 (17.7)	551 (20.7)	7594 (17.5)	
Use of work-related communication devices outside regular working hours				<.0001
Unuse	20 396 (44.3)	780 (29.3)	19 616 (45.2)	
Use	25 659 (55.7)	1884 (70.7)	23 775 (54.8)	

[a]Values are presented as number (%).
[b]P values are computed using $\chi2$ test.

Table 2. Multiple logistic regression results for anxiety symptoms according to use of work-related communication devices outside regular working hours.[a]

| Symptom | Model[b] | Use of work-related communication devices outside regular working hours | | | | | |
| | | Total ($n = 46\,055$) | | Male ($n = 22\,152$) | | Female ($n = 23\,903$) | |
		Unuse ($n = 20\,396$)	Use ($n = 25\,659$)	Unuse ($n = 9170$)	Use ($n = 12\,982$)	Unuse ($n = 11\,226$)	Use ($n = 12\,677$)
Anxiety	Crude	Ref.	1.99 (1.83-2.17)	Ref.	2.18 (1.91-2.48)	Ref.	1.88 (1.68-2.11)
	Adjusted	Ref.	2.13 (1.95-2.33)	Ref.	2.23 (2.01-2.64)	Ref.	1.99 (1.77-2.25)

[a]Data are presented as odds ratio (95% CI). [b]The model was adjusted for gender, age, educational level, household monthly income, occupation type, self-reported health conditions, and weekly working hours.

in the total subjects. In the male subgroup that OR was 1.49 (95% CI, 1.14-1.95), in the female subgroup it was 1.13 (95% CI, 0.87-1.48). The group that worked more than 52 h/wk and used work-related communication devices outside of working hours had the highest OR. In the total subjects it was 2.57 (95% CI, 2.24-2.97), in the male subgroup it was 2.96 (95% CI, 2.43-3.60), and in the female subgroup it was 2.16 (95% CI, 1.77-2.64).

Regardless of gender, the group that used work-related communication devices outside regular working hours without working long hours showed higher ORs than the group that worked long hours alone. However, in the female subgroup, the results for the group working long hours alone were not statistically significant.

Discussion

The present study revealed that the use of work-related communication devices outside regular work hours is associated with an increased risk of anxiety. Furthermore, it was confirmed that using work-related communication devices outside of working hours was associated with a greater risk of developing anxiety symptoms than long working hours. These results are consistent

Table 3. Multiple logistic regression results for anxiety symptoms according to use of work-related communication devices outside regular working hours and long working hours.[a]

			Use of work-related communication devices outside regular working hours			
			Working hours ≤52 h/wk (n = 37 910)		Working hours >52 h/wk (n = 8145)	
Symptom	Gender	Model[b]	Unuse (n = 17 029)	Use (n = 20 881)	Unuse (n = 3367)	Use (n = 4778)
Anxiety	Total	Crude	Ref.	2.00 (1.81-2.22)	1.22 (1.02-1.47)	2.38 (2.09-2.71)
		Adjusted	Ref.	2.18 (1.97-2.41)	1.32 (1.09-1.59)	2.57 (2.24-2.97)
	Male	Crude	Ref.	2.23 (1.91-2.59)	1.45 (1.11-1.88)	2.88 (2.39-3.47)
		Adjusted	Ref.	2.42 (2.06-2.83)	1.49 (1.14-1.95)	2.96 (2.43-3.60)
	Female	Crude	Ref.	1.88 (1.66-2.12)	1.09 (0.85-1.41)	2.06 (1.70-2.48)
		Adjusted	Ref.	2.00 (1.76-2.29)	1.13 (0.87-1.48)	2.16 (1.77-2.64)

[a]Data are presented as odds ratio (95% CI). [b]For the total group, the model was adjusted for sex, age, educational level, household monthly income, occupation type, and self-reported health status. For the male and female groups, the model was adjusted for age, educational level, household monthly income, occupation type, and self-reported health status.
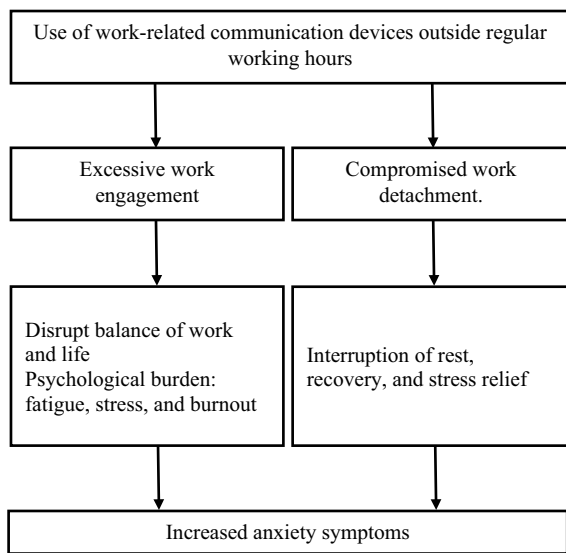
Figure 2. The link between use of work-related communication devices outside of regular work time and anxiety symptoms.

with previous research demonstrating the negative impact that use of work-related communication devices outside regular working hours can have on mental health.[3,4]

We found that using work communication devices outside of working hours is associated with increased the risk of anxiety symptoms, regardless of gender. The use of such devices outside regular working hours can lead to excessive work engagement and hinder work detachment in employees (Figure 2). Work engagement refers to the emotional involvement or commitment of workers toward their work,[22] and when excessive it can disrupt the balance between work and personal life.[23] This can lead to an increase in fatigue, stress, burnout,[24] and consequently induce anxiety symptoms. Contrastingly, work detachment refers to an individual's sense of being away from work situations.[25] According to other studies, detachment from work during off-hours is beneficial for workers' well-being and job performance.[26] However, when work-related communication devices are used outside regular working hours, work detachment is compromised,[27–29] which negatively affects rest and stress relief. This can potentially manifest as heightened anxiety symptoms and adverse mental health effects.

Moreover, this study suggests that using work-related communication devices outside of working hours poses a greater risk of developing anxiety symptoms than working long hours alone. Although long working hours may have a defined end time, the use of work-related communication devices can extend beyond working hours. This blurs the boundaries between work and private life, leaving workers disconnected from their daily lives and negatively affecting their mental health. Moreover, the unpredictability of work-related contact can negatively affect mental health by limiting autonomy and control over one's life. Currently, most working hours calculations do not include business contacts outside of working hours, and only consider actual working hours. However, this study indicates that the use of communication devices for work outside of working hours is associated with greater risk to workers' anxiety than working long hours. Therefore, discussions regarding the definition of working hours should encompass the use of communication devices for work outside of working hours.

Furthermore, the highest risk of anxiety was observed when both work-related communication devices were used during off-hours and long working hours were present. Previous studies have shown that long working hours increase the likelihood of experiencing depression and anxiety.[30,31] Both prolonged working hours and the use of work-related communication devices outside of working hours increase workers' work engagement, and it is thought that the highest risk of anxiety symptoms occurs when both effects are present simultaneously.

To the best of our knowledge, this study is the first attempt to investigate and compare the association between long working hours and the use of work-related communication devices outside of regular work hours and health. It is valuable in providing insights for the redefinition of working hours by comparing the respective association of communication devices for work outside working hours and long hours of work. This study used a large population to examine the relationship between work-related communication device use outside working hours and anxiety symptoms, encompassing various forms of contact including phone calls, emails, Social Network Service (SNS), social media, and various other applications.

However, this study has several limitations. Firstly, the presence of anxiety symptoms was determined using only a single question regarding subjective anxiety complaints. However, to evaluate anxiety clearly, a process is required to secure the objectivity of subjective indicators using a structured questionnaire.

Additionally, a group of workers ($n = 4483$) was excluded according to the exclusion criteria, resulting in sociodemographic differences observed between the study population and the exclusion group. Specifically, the excluded group had a lower socioeconomic status than that of the study participants (Table S1). Therefore, the results of this study may be biased. Finally, owing to the cross-sectional nature of this study, it was not possible to confirm a causal relationship between variables.

Conclusions

This study found compelling evidence indicating that the use of work-related communication devices outside working hours is strongly associated with anxiety symptoms. The use of work-related communication devices outside of working hours is associated with a higher risk of developing anxiety symptoms than long working hours. Therefore, when redefining working hours, it is necessary to discuss use of work-related communication devices outside working hours and the resulting work time. It also suggests the need to establish a regulatory policy on the use of communication devices for work outside regular working hours.

Author contributions

S.K. and W.L. conceived the ideas. S.K., S.H., and W.-J.C. conducted statistical analysis. S.K., S.H., W.-J.C. and W.L. interpreted the data. S.K. and W.L. drafted the manuscript. S.K., S.H., W.-J.C., S.-K.K., and W.L. revised the manuscript and approved the final version of the manuscript. W.-J.C. and W.L. supervised the study. Won-Jun Choi and Wanhyung Lee contributed equally to this work.

Conflicts of interest

The authors declare no conflict of interests for this article.

Data availability statement

The data that support the findings of this study are derived from sixth Korean Working Conditions Survey; the resources are available in the public domain (https://oshri.kosha.or.kr/eoshri/resources/KWCSDownload.do).

Supplementary material

Supplementary material is available at *Journal of Occupational Health* online.

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