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How the pandemic shaped presenteeism trends between healthcare and non-healthcare workers using the Korean working conditions surveys (2010–2023)

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Presenteeism, the act of working while unwell, presents serious risks to both workers and organizations, especially in healthcare, where it directly affects patient-care quality. The COVID-19 pandemic has intensified these risks, particularly for healthcare workers facing increased workload pressure. Although the impact of presenteeism on workers has been widely studied, a critical gap remains in our understanding of how its patterns have shifted over time. Therefore, this study examined presenteeism trends using the Korean Working Conditions Surveys (2010–2023), focusing on healthcare workers and the effects of age and sex before and after the COVID-19 pandemic. The results indicated that presenteeism peaked in 2014, declined sharply in 2020, and reached its lowest level by 2023. Healthcare workers exhibited high presenteeism rates prior to the pandemic; however, during and after the pandemic, these rates decreased rapidly and ultimately became lower than those of non-healthcare workers. Older and female healthcare workers showed higher presenteeism (i.e., were more likely to work while ill), and these trends persisted even after the pandemic. These findings underscore the need for sex- and age-sensitive workplace interventions for healthcare workers to promote healthier work environments and mitigate the risk of presenteeism.

Keywords Presenteeism, Healthcare workers, COVID-19, Occupational health, Pandemic

Healthcare workers are vital to the sustainability of any healthcare system, and the COVID-19 pandemic has highlighted the importance of their continuous presence. However, beyond their essential role, healthcare workers have long faced the challenge of presenteeism, the act of working while sick, which is particularly prevalent in this group owing to both organizational demands and cultural expectations[1]. As healthcare workers struggled to meet the surging demand for care, many found themselves continuing to work despite physical illness or mental distress, exacerbating an already critical problem that predates the pandemic. Presenteeism is particularly concerning in the healthcare sector, where worker well-being directly affects patient safety and care quality[2]. In South Korea, where the healthcare environment is highly demanding and the work culture emphasizes long hours and a strong sense of duty, understanding presenteeism among healthcare workers is particularly important[3]. Despite global research on presenteeism, limited attention has been paid to how it evolves in non-Western contexts, such as Korea, where cultural and systemic factors may lead to distinct patterns. Therefore, by understanding the unique Korean context, we can extend the literature on presenteeism and occupational health. Hence, this study investigates presenteeism trends among healthcare workers in South Korea from 2010 to 2023, focusing on how patterns evolved during and after the pandemic. To provide a broader context and highlight the unique characteristics of healthcare workers, we also compared these trends to those observed in non-healthcare occupational groups.

Presenteeism among healthcare workers has been shaped by both pre-existing pressures and the extraordinary circumstances of the COVID-19 pandemic. Prior to the COVID-19 pandemic, research has consistently indicated that healthcare workers experienced higher levels of presenteeism than other professions, driven by concerns about patient care, staff shortages, and institutional expectations[1,2,4]. However, the pandemic has

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exacerbated these factors, leading to unprecedented levels of presenteeism in healthcare settings. Healthcare workers not only face an increased risk of COVID-19 exposure but also deal with mounting psychological strain and burnout[5].

Following the acute phase of the pandemic, many non-healthcare sectors adopted flexible work arrangements, such as hybrid models, effectively reducing physical presenteeism. However, these arrangements have led to virtual presenteeism, with employees continuing to work from home despite illness, thus blurring the boundaries between health and productivity[6]. Conversely, healthcare workers face limited flexibility because of the essential in-person demands of their roles, resulting in the persistence of high presenteeism levels[7]. Although initial pandemic concerns temporarily lowered presenteeism due to infection fears[8], the prolonged crisis and strained healthcare systems led many workers to revert to working while ill, driven by professional obligations and job security concerns[9]. In this context, presenteeism has become an embedded mechanism within healthcare institutions that is necessary for managing resource constraints and addressing overwhelming service demands[10].

The pandemic has also increased awareness of health and safety risks. Initially, health precautions and quarantine measures led to temporary reductions in presenteeism as workers were encouraged to prioritize their health. However, as the pandemic progressed, the pressure to maintain productivity coupled with the economic instability faced by healthcare institutions increased the prevalence of presenteeism[5]. Healthcare workers facing a global health crisis have reported high levels of stress, anxiety, and burnout, which further contribute to presenteeism[11].

One promising post-pandemic development is the increased organizational emphasis on employee well-being. Many healthcare institutions have begun prioritizing mental health and well-being initiatives, actively discouraging presenteeism through psychological support services[12]. Enhanced health and safety protocols, including clear sick leave policies and mental health support, are expected to restraint presenteeism among healthcare workers. However, evidence suggests that these measures may not be uniformly applied across all healthcare sectors, and gaps in the implementation of well-being programs persist[12]. Additionally, while institutional changes are a step in the right direction, true cultural shifts in how presenteeism is viewed and addressed within healthcare require sustained efforts at both the leadership and organizational levels[6].

In addition to organizational and pandemic-related factors, demographic characteristics such as age and sex have been shown to influence presenteeism rates among healthcare workers. However, the existing literature does not provide a uniform conclusion regarding age-related differences in presenteeism. Some studies report that younger workers are more likely to exhibit presenteeism because of concerns about job security and career advancement[2]. These workers, who are often in the early stages of their careers, may feel the pressure to prove themselves and fear that taking sick leave could hinder their professional progress. The economic uncertainty brought on by the pandemic exacerbated these concerns, leading younger workers to attend work despite their illness[8]. Conversely, other research suggests that older healthcare workers tend to prioritize their health more, particularly in light of the higher risks associated with COVID-19, and are more likely to take sick leave when unwell (i.e., lower presenteeism), especially during a pandemic[5]. Nevertheless, these age-related patterns are not consistent across studies. For instance, although research from Japan indicates that older employees exhibit lower rates of presenteeism, studies on Chinese healthcare workers have reported higher rates of presenteeism in older groups[13,14]. Such discrepancies may reflect differences in workplace culture, levels of professional responsibility, and organizational expectations across various contexts. Despite these mixed findings, presenteeism remains a concern for both younger and older healthcare workers, particularly in settings where staff shortages make it difficult to take time off.

Sex is another critical factor that affects presenteeism. Research has shown that women, particularly those with caregiving responsibilities, are more likely to engage in presenteeism than their male counterparts[9]. During the pandemic, many female healthcare workers faced the additional burden of managing both professional responsibilities and increasing caregiving duties at home. This dual pressure leads to higher rates of presenteeism among women, who often feel that they have no choice but to continue working despite their illness[9]. For male healthcare workers, presenteeism is often driven by traditional norms surrounding work ethics and productivity, particularly in male-dominated medical specialties[12]. However, how these demographic factors interact with pandemic-related changes and whether the observed trends in other countries also apply to South Korea are some aspects that are not entirely addressed in the literature.

Although the impact of presenteeism has been widely studied globally, a critical gap in understanding how its prevalence has changed over time, particularly with respect to age- and sex-related differences, still exists. Therefore, we investigated long-term trends in presenteeism among Korean workers using 13 years of data (2010–2023) from the Korean Working Conditions Survey (KWCS). By comparing the trends between workers in healthcare and non-healthcare sectors, we aimed to determine whether the unique working environments of healthcare professionals have resulted in distinct patterns of presenteeism before, during, and after the COVID-19 pandemic. In addition, this study explores how demographic factors—particularly age and sex—have influenced these trends, with particular attention to the intersection of these characteristics and occupational pressure experienced by healthcare workers. By combining a nationally representative, longitudinal dataset with a comparative analysis of occupational groups and key demographic variables, we aim to provide new insights into the evolving patterns and determinants of presenteeism during a period of major societal change.

Methods

Settings

This study analyzed data from the KWCS, a national survey conducted by the Korea Occupational Safety and Health Research Institute. The KWCS is a comprehensive dataset covering a wide array of topics, including employment status, working conditions, health and safety, and self-reported work behaviors, making it a valuable resource for occupational health research. The KWCS was based on household visit interviews, and the first

survey was conducted in 2006, followed by the second in 2010, and the third in 2011. Since then, four additional surveys have been conducted every 3 years from 2014 to 2023, bringing the total number of completed surveys to seven[15]. The data analyzed in this study span from the second KWCS (2010) to the seventh KWCS (2023), including the pre-, pandemic, and post-pandemic years, providing a unique perspective on how presenteeism has evolved over time. The KWCS includes responses from workers across various industries, thus making it representative of the South Korean workforce.

Sample

The KWCS targets employed people aged 15 years or older nationwide, including workers, business owners, and self-employed individuals. The survey districts from the Population and Housing Census were used as the sampling frame, stratified by region, urbanization level, and residence, and the survey districts were randomly sampled within each stratum. Systematic sampling was performed within each survey district using the survey register. Eligible survey subjects were selected and surveyed after identifying households in which at least one member was employed. The target number of respondents for the first two waves was 10,000, and the target number of respondents for the third wave and beyond was 50,000. The total sample size across the six survey periods was 260,996 (Fig. 1). After excluding participants with missing data (n = 1, 360) and those who reported no illness or absence in the past 12 months (n = 30,387), the final sample size for analysis was 229,249 participants. These individuals were further categorized into those who had experienced presenteeism (n = 44,696) and those who had not (n = 184,553). Occupations were classified as healthcare and non-healthcare workers, with healthcare workers comprising 4.9% of the sample and non-healthcare workers comprising 95.1% of the sample.

Measures

The main outcome variable was presenteeism, which was measured based on participants' self-reports of whether they had worked while sick or injured in the past 12 months. It was treated as a binary variable (yes or no). This method follows the original operationalization of sickness presenteeism proposed by Aronsson et al. (2000)[16] that has been widely adopted in large-scale national and international surveys, including the European Working Conditions Survey (EWCS), as well as in subsequent research[1,2]. The key independent variable was an occupation, categorized as healthcare or non-healthcare workers, based on the respondents' job classifications. Healthcare workers included nurses, physicians, and other allied health professionals, whereas non-healthcare workers included all other occupations. Age was grouped into five categories: < 30 years, 30–39 years, 40–49 years, 50–59 years, and ≥ 60 years, allowing for an analysis of age-related trends in presenteeism. Sex was categorized as male or female, as the survey only provided these two options, and its role in presenteeism was explored to assess potential sex disparities.

Several potential confounders, selected according to their theoretical and empirical relevance[17,18], were included in all multivariable analyses to control for factors that might influence presenteeism rates and to estimate independent associations. These confounders included participants' monthly income (< 200, 200–299, 300–399, and ≥ 400; unit: 1,000 KRW), region (classified as metropolitan vs. non-metropolitan), and occupational position according to the Korean Standard Classification of Occupations (KSCO), grouped as high-skilled (managers,

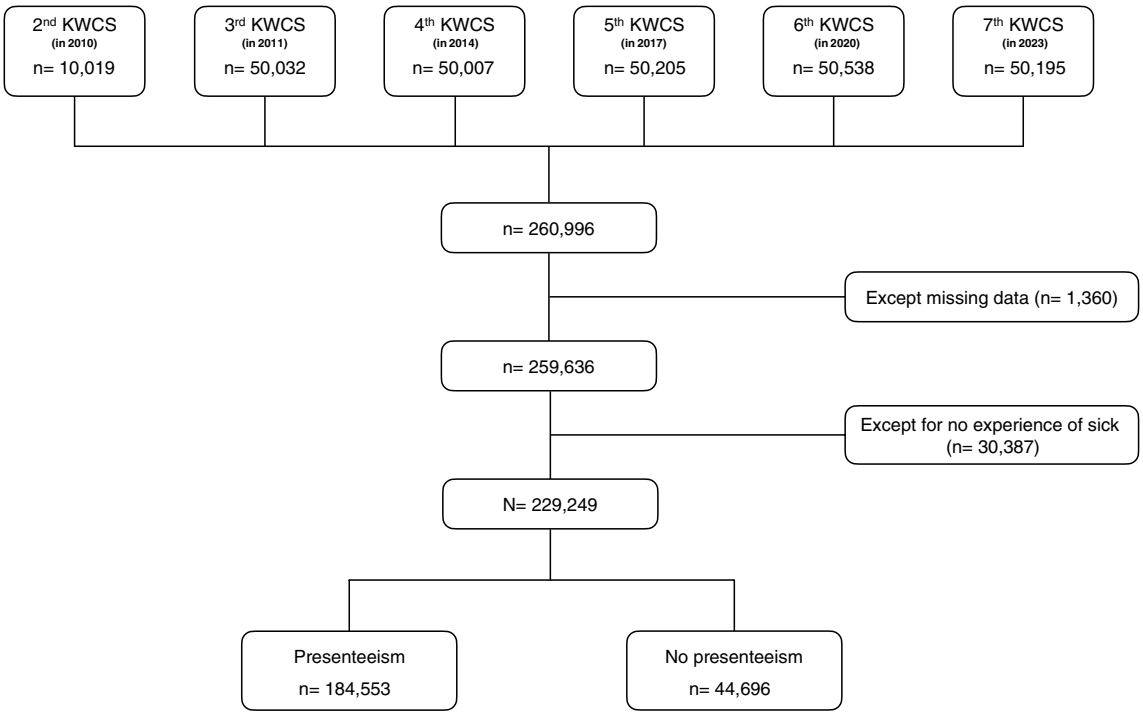

Fig. 1. Flow chart of study population.

professionals, clerical support workers) and low-skilled (service workers, sales workers, agricultural workers, craft workers, machine operators, and elementary occupations). Subjective health status (SHS) was also included as a confounder; participants rated their health as "Very Good," "Good," "Fair," "Poor," or "Very Poor." For the purpose of the analysis, SHS was dichotomized into two categories: "Healthy" (combining "Very Good," "Good," and "Fair") and "Unhealthy" (combining "Poor" and "Very Poor").

Statistical analysis

A series of statistical analyses were performed to explore trends in presenteeism over time and across demographic groups. The datasets were weighted to ensure the representativeness of the national workforce, and analyses were conducted using these weighted data to provide accurate estimates of presenteeism prevalence across different occupational groups and demographic categories. Descriptive statistics were first calculated to summarize the demographic characteristics of the study population, including mean age, sex distribution, and occupation. Presenteeism rates were then examined across different years, stratified by healthcare and non-healthcare workers, age group, and sex. Time trends in presenteeism were visualized using line graphs, with particular attention paid to the differences between the pre-pandemic (2010, 2011, 2014, and 2017), pandemic (2020), and post-pandemic (2023) periods.

Bivariate analyses were conducted to examine the unadjusted associations between presenteeism and each potential confounder, including monthly income, region, occupational position, and subjective health status. Confounders that were either statistically significant in bivariate analyses or deemed theoretically important based on prior literature were subsequently included in the final multivariable logistic regression models.

Logistic regression models were used to assess the impact of demographic factors on presenteeism. The dependent variable was the likelihood of reporting presenteeism, and the independent variables included age, sex, and occupation. The survey year was included as a categorical variable to account for temporal changes. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to estimate the strength of the association between these factors and presenteeism. The models were adjusted for potential confounders, and a p-value of < 0.05 was considered statistically significant. All statistical analyses were conducted using R, Version 4.4.1 (R Foundation for Statistical Computing), with survey weights applied to ensure the generalizability of the results to the national working population.

Given the substantial overrepresentation of females in the healthcare worker group, we conducted sensitivity analyses by stratifying the sample by sex and repeating the survey-weighted regression models separately for males and females. This approach allowed us to evaluate whether the associations observed in the overall analysis were consistent within each sex and to assess the potential impact of sex imbalance on our main findings.

Ethical considerations

This study was based on publicly available data from the KWCS, which were fully anonymized and did not contain personally identifiable information. As the data were secondary and publicly accessible, the research posed no risk to the individual participants. Additionally, the first author obtained an Institutional Review Board exemption approval from Chung-Ang University (No. 1041078–20,241,017-HR-294) as the study was deemed exempt from full ethical review under the guidelines for research using publicly available anonymized data. All procedures followed the ethical standards of the Korean Occupational Safety and Health Agency and adhered to the international ethical guidelines for research involving human subjects.

Results

Table 1 summarizes the overall demographic characteristics of the study participants across all survey years from 2010 to 2023. The total sample size was 229,249 individuals with a mean age of 46.3 years. The largest age group was those aged 40–49 (25.5%), followed by participants aged 50–59 (22.7%) and 30–39 (21.4%). Younger participants under 30 years represented 12.9% of the sample, whereas older participants aged 60 years and older accounted for 17.5%. The sex distribution showed that 56.7% of the participants were male and 43.3% were female. The proportion of healthcare workers in the total sample was 3.2%, with non-healthcare workers comprising the majority (96.8%). Across all participants, the proportions of specific healthcare occupations during the survey years were as follows: nurses accounted for approximately 0.8–1.5%, physicians for 0.2–0.4%, and allied health professionals for 0.9–2.5% (see Supplementary Table 1 for year-by-year data). When restricted to the healthcare worker group, nurses represented about 37–43%, physicians, 4–16%, and allied health professionals, 43–60% of healthcare workers, depending on the survey year.

Figure 2 presents the trends in presenteeism over the years and shows some fluctuations. Between 2010 and 2014, presenteeism steadily increased, peaking at approximately 25% in 2014. After 2014, the rate began to decline, with a sharp drop around 2020, the year of the pandemic, as indicated by the red dashed line. This downward trend continues into the post-pandemic period, marked by the dashed green line, with the lowest presenteeism rate observed in 2023 (below 10%).

Figure 3 illustrates a comparison of presenteeism rates between healthcare (yellow line) and non-healthcare workers (blue line) over time. The presenteeism rate for healthcare workers was higher than that for non-healthcare workers in 2010, peaked around 2014 for both groups and then began to decline steadily. In the pandemic year (2020), both groups experienced a sharp decline in presenteeism rates. During the post-pandemic period, presenteeism rates decreased even more pronounced, with healthcare workers exhibiting lower rates in 2023 than non-healthcare workers.

Figure 4 illustrates presenteeism rate trends by age group from 2010 to 2023, with Fig. 4a representing the overall sample and Fig. 4b focusing on healthcare workers. In the overall sample (Fig. 4a), all age groups saw an increase in presenteeism rates until 2014, with the oldest groups (50–59 and 60+) consistently showing higher rates than the younger groups. After 2014, the presenteeism rates steadily declined across all age groups, with a

	Survey years						Total
	2010	2011	2014	2017	2020	2023	
	n = 10,019	n = 50,032	n = 47,967	n = 42,556	n = 37,055	n = 41,620	N = 229,249
	Mean (SE) or % (SE)						
Age	45.0 (0.136)	44.6 (0.062)	45.1 (0.074)	46.4 (0.090)	48.1 (0.116)	48.5 (0.099)	46.3 (0.037)
Age group							
< 30	11.4 (0.004)	11.8 (0.002)	14.6 (0.002)	13.5 (0.003)	11.9 (0.003)	12.7 (0.003)	12.9 (0.001)
30–39	24.0 (0.005)	25.7 (0.002)	22.0 (0.002)	20.5 (0.003)	18.3 (0.003)	18.4 (0.003)	21.4 (0.001)
40–49	30.3 (0.005)	29.3 (0.002)	26.0 (0.003)	24.5 (0.003)	23.7 (0.004)	21.5 (0.003)	25.5 (0.001)
50–59	20.0 (0.004)	20.1 (0.002)	23.0 (0.002)	24.0 (0.003)	24.4 (0.003)	23.6 (0.003)	22.7 (0.001)
≥ 60	14.3 (0.004)	13.2 (0.002)	14.4 (0.002)	17.5 (0.002)	21.7 (0.003)	23.9 (0.002)	17.6 (0.01)
Sex							
Male	54.3 (0.005)	58.1 (0.002)	57.7 (0.003)	56.3 (0.003)	56.0 (0.004)	55.3 (0.003)	56.7 (0.001)
Female	45.7 (0.005)	41.9 (0.002)	42.3 (0.003)	43.7 (0.003)	44.0 (0.004)	44.7 (0.003)	43.3 (0.001)
Occupation							
Healthcare worker	2.0 (0.002)	2.9 (0.001)	3.2 (0.001)	3.5 (0.001)	2.9 (0.001)	4.1 (0.001)	3.2 (0.002)
Non-healthcare worker	98.0 (0.002)	97.1 (0.001)	96.8 (0.001)	96.5 (0.001)	97.1 (0.001)	95.9 (0.001)	96.8 (0.001)
Region							
Metropolitan area	72.3 (0.005)	72.4 (0.002)	68.8 (0.002)	69.3 (0.003)	68.8 (0.004)	71.1 (0.003)	70.3 (0.001)
Non-metropolitan area	27.7 (0.005)	27.6 (0.002)	31.2 (0.002)	30.7 (0.003)	31.2 (0.004)	28.9 (0.003)	29.7 (0.001)
Monthly income (1,000KRW)							
< 200	51.5 (0.005)	46.8 (0.003)	31.3 (0.003)	32.6 (0.003)	28.6 (0.004)	20.5 (0.003)	33.6 (0.001)
200–300	21.6 (0.004)	27.3 (0.002)	20.6 (0.002)	27.0 (0.003)	29.2 (0.004)	29.6 (0.003)	26.3 (0.001)
300–400	11.5 (0.004)	14.5 (0.002)	11.9 (0.002)	21.4 (0.003)	20.6 (0.003)	26.9 (0.003)	18.2 (0.001)
≥ 400	15.4 (0.004)	11.4 (0.002)	36.2 (0.003)	19.0 (0.003)	21.6 (0.004)	23.0 (0.003)	21.9 (0.001)
Occupational position							
Low-skilled	34.9 (0.005)	36.2 (0.003)	37.9 (0.003)	38.3 (0.003)	37.7 (0.004)	39.7 (0.003)	37.8 (0.001)
High-skilled	65.1 (0.005)	63.8 (0.003)	62.1 (0.003)	61.7 (0.003)	62.3 (0.004)	60.3 (0.003)	62.2 (0.001)
Subjective health status							
Healthy	93.7 (0.003)	95.6 (0.001)	95.3 (0.001)	96.5 (0.001)	94.2 (0.002)	94.2 (0.001)	95.1 (0.001)
Unhealthy	6.3 (0.003)	4.4 (0.001)	4.7 (0.001)	3.5 (0.001)	5.8 (0.002)	5.8 (0.002)	4.9 (0.001)

Table 1. Demographic characteristics of study participants by survey year (2010–2023). *SE* standard error. 1 USD = 1370 KRW. Allied health professionals include pharmacists, herbalists, nutritionists, therapists, medical technicians, and other healthcare workers.

sharp drop during the pandemic year (2020) continuing into the post-pandemic period. By 2023, all age groups will exhibit significantly lower presenteeism rates than their 2014 peaks, with the under-30 group showing the lowest rates, while older groups will still have relatively higher rates, although the sharpest declines occurred post-2020.

As seen in Fig. 4b, the trends of healthcare workers showed more variation than those of the overall sample. The 40–49-year-old age group had the highest presenteeism rate in 2010, while the 50–59-year-old age group had the lowest rate. Over time, presenteeism in the 40–49-year-old age group declined, while the 50–59-year-old age group showed peaks around 2017, and in both groups, presenteeism sharply declined in the post-pandemic period. Presenteeism in the > 60-year-old age group was relatively high in 2010, declined steadily, and showed a sharp decline by 2023. Presenteeism in the < 30 and 30–39-year-old age groups showed large fluctuations, but eventually showed a notable decline after the pandemic year (2020) and further into the post-pandemic period. By 2023, the presenteeism trends in all age groups converged closely, exhibiting similar rates.

Figure 5a,b compare presenteeism rates by sex, with the first figure representing all participants and the second focusing specifically on healthcare workers from 2010 to 2023. In both figures, female workers consistently showed higher presenteeism rates than male workers. In Fig. 5a, which includes all participants, presenteeism rates for both sexes increased until 2014, followed by a steady decline, with a sharp drop in 2020 during the pandemic. By 2023, the sex gap narrowed significantly. In Fig. 5b, which focuses on healthcare workers, female presenteeism rates peaked in 2014, while male presenteeism rates steadily dropped. Both sexes experienced a sharp decline in 2020 and further reductions after the pandemic. However, by 2023, the sex gap in the healthcare worker group, while reduced, remained more pronounced than that in the overall participant group.

Table 2 presents the results of logistic regression analysis examining the relationship between demographic factors and presenteeism rates after adjusting for all confounders. Age was positively associated with presenteeism (odds ratio [OR] = 1.01, 95% CI 1.00–1.01), indicating that as workers aged, the likelihood of exhibiting presenteeism increased. Female workers were 33% more likely than male workers to report presenteeism (OR = 1.33, 95% CI 1.30–1.37). Healthcare providers were 22% more likely to report presenteeism than non-

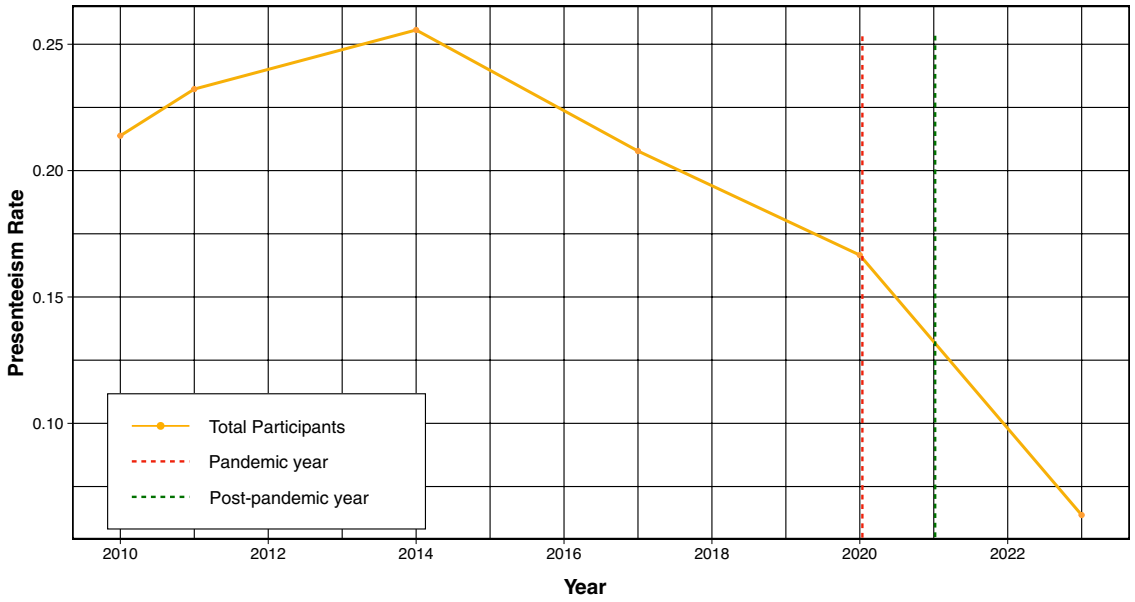

Fig. 2. Trends in presenteeism rate among study participants (2010–2023).

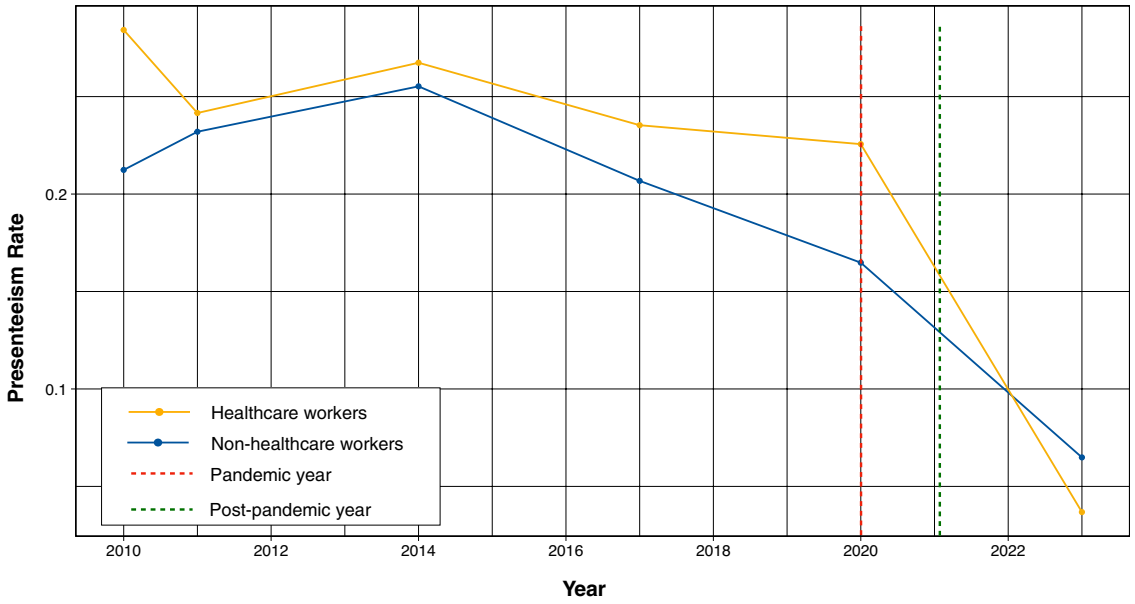

Fig. 3. Comparison of presenteeism rates between healthcare workers and non-healthcare workers (2010–2023).

healthcare workers (OR = 1.22, 95% CI 1.12–1.33). Regarding survey years, the odds of presenteeism increased in 2011 (OR = 1.13) and 2014 (OR = 1.21) compared with those in 2010. However, from 2017, the odds began to decrease, with significant reductions in 2020 (pandemic year, OR = 0.68) and 2023 (post-pandemic year, OR = 0.22), indicating a substantial decline in presenteeism rates by the end of the study period.

Sensitivity analysis

To assess the robustness of our findings given the higher proportion of females (74.4%) among healthcare workers, we conducted survey-weighted regression analyses separately for female and male participants (Table 3). The results were generally consistent across sexes. Sensitivity analyses revealed that being a healthcare worker was significantly associated with higher odds of presenteeism in females (OR = 1.19, 95% CI: 1.08–1.32), but not in males (OR = 1.07, 95% CI 0.91–1.26). In both groups, increased age, high income, and low-skilled occupations were associated with increased odds of presenteeism, whereas a good subjective health status and living in a non-metropolitan area were associated with lower odds. The effect of survey year was consistent, with all years

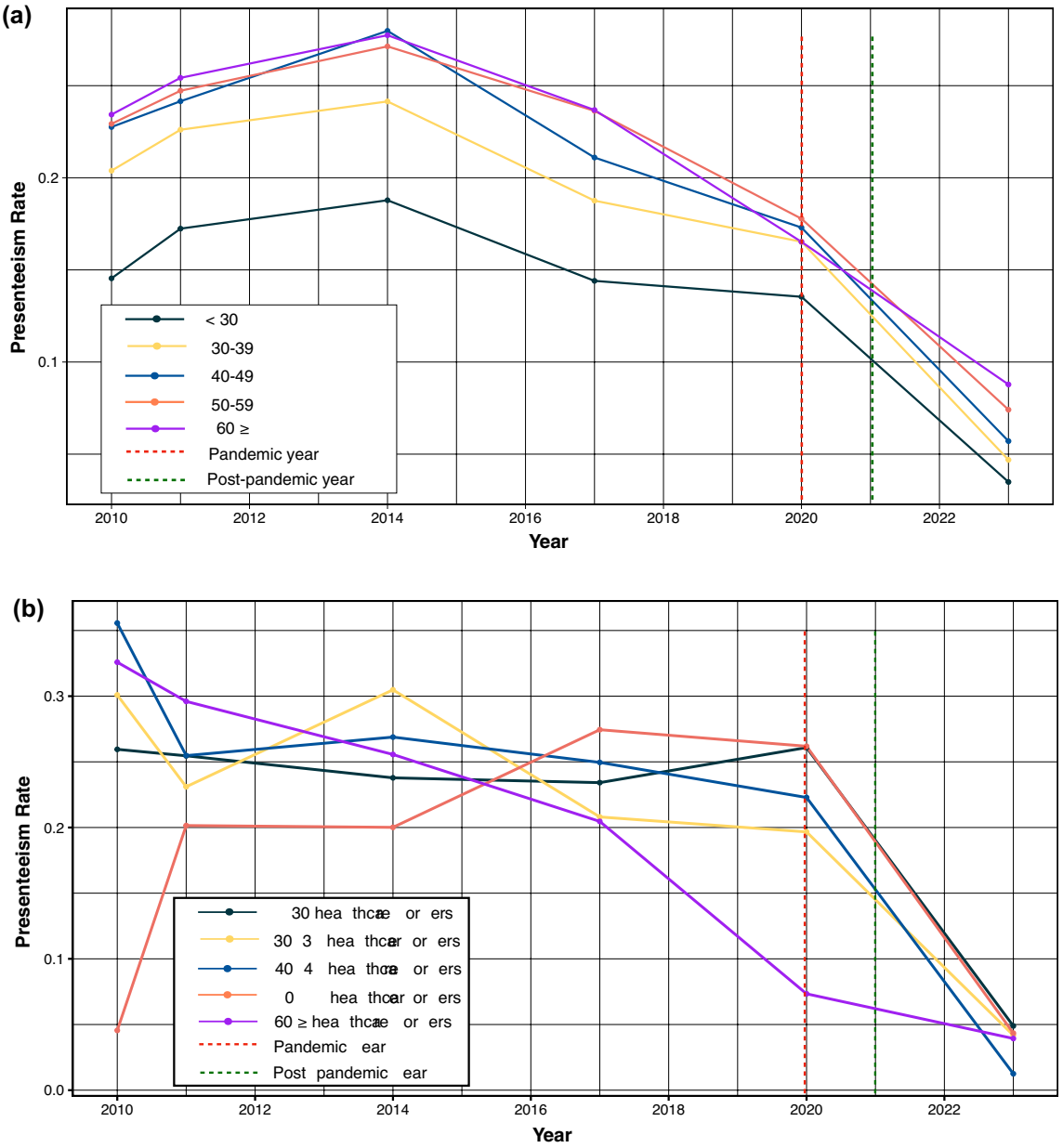

Fig. 4. Presenteeism rate trends by age group (2010–2023). (**a**) All participants (**b**) Healthcare workers.

except for the year 2017 showing significance; notably, the odds of presenteeism were substantially lower in 2020 and 2023 than in 2010. These findings confirm the robustness of the main results, with the association between healthcare worker status and presenteeism observed only among females.

Discussion

This study aimed to explore presenteeism trends among healthcare and non-healthcare workers from 2010 to 2023 using data from the Korean Working Conditions Survey. Our findings highlight important differences in presenteeism rates between these two groups, particularly in relation to sex and age, and underscore how the COVID-19 pandemic has shaped these patterns over time. The results provide valuable insights into the dynamics of presenteeism in the healthcare sector compared with broader industry trends and suggest important implications for workplace health policies and future research directions.

Presenteeism has been a persistent issue among both healthcare and non-healthcare workers, but trends over time have differed notably between these groups. Our analysis indicated that presenteeism rates peaked around 2014, followed by a steady decline, especially after the COVID-19 pandemic. The 2015 Middle East Respiratory Syndrome (MERS) outbreak played a significant role in raising awareness of the risks of infectious disease spread, contributing to a shift in attitudes toward presenteeism. With the growing recognition that going to work when sick can harm both individual and public health, presenteeism has shown a downward trend since

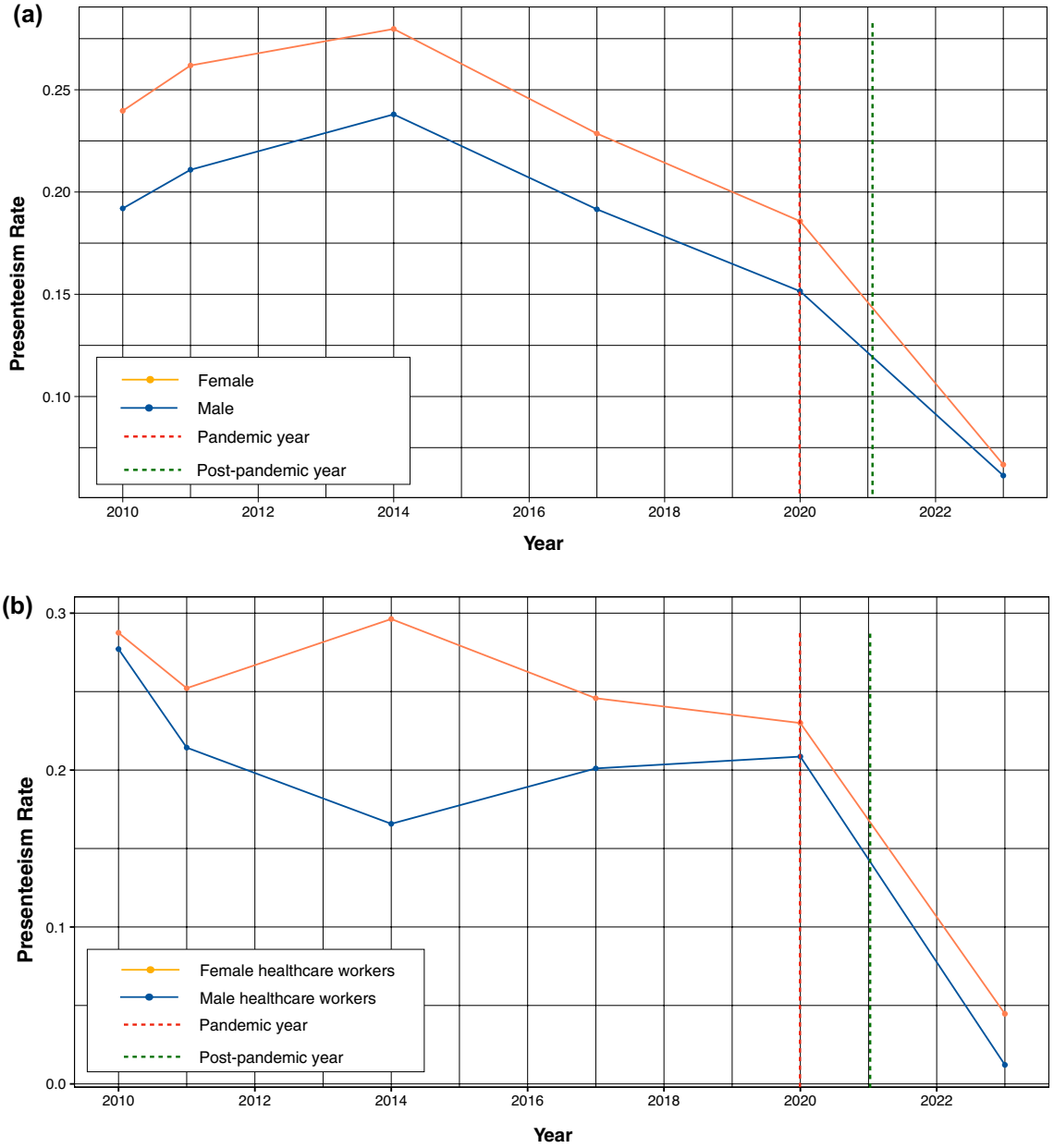

Fig. 5. Presenteeism rate trends by sex (2010–2023).

2014. During the pandemic year (2020), presenteeism rates dropped sharply in both sectors and continued to decline during the post-pandemic period. However, the trajectories of healthcare workers showed greater variability, with sex and age playing pronounced roles.

One critical finding from the logistic regression was that healthcare workers were 14% more likely to engage in presenteeism than non-healthcare workers, highlighting the unique pressures faced by healthcare workers, especially during the pandemic[19]. The nature of healthcare work, which requires a physical presence and direct patient care, makes it difficult for these workers to work remotely or take time off when sick[1]. This was particularly evident during the pandemic when healthcare systems were overwhelmed, and many workers felt a moral obligation to continue working despite being unwell[20]. In contrast, the working conditions of non-healthcare workers were more flexible during the pandemic, with many industries adopting remote work or flexible schedules[7,21]. This is likely to explain the sharp decline in presenteeism rates among non-healthcare workers after the pandemic, as these workers had more opportunities to take sick leave or work from home when needed. The availability of these options in non-healthcare workers likely helped mitigate the need for presenteeism, contributing to the uniform decline in the rates observed in the overall sample. Presenteeism poses a dual risk to healthcare. Not only does it harm the health of the workers themselves, but it also threatens the quality of patient care[1,14]. Given these risks, healthcare employers must recognize the dangers of presenteeism and implement policies that support workers to take time off when needed. The COVID-19 pandemic underscores the urgent

Variable	Coefficient	SE	OR (95% CI)
Age	0.01	0.001	1.01 (1.00, 1.01)
Sex (ref. male)	0.29	0.015	1.33 (1.30, 1.37)
Occupation (ref. non-healthcare worker)	0.20	0.043	1.22 (1.12, 1.33)
Years (ref. 2010)			
2011	0.13	0.030	1.13 (1.07, 1.20)
2014	0.19	0.031	1.21 (1.14, 1.29)
2017	− 0.05	0.032	0.95 (0.89, 1.01)
2020	− 0.38	0.036	0.68 (0.64, 0.73)
2023	− 1.50	0.040	0.22 (0.21, 0.24)
Region (ref. metropolitan area)	− 0.17	0.015	0.84 (0.82, 0.87)
Monthly income (1,000 KRW; ref. < 200)			
200–300	0.22	0.019	1.25 (1.20, 1.30)
300–400	0.26	0.023	1.30 (1.24, 1.36)
≥ 400	0.34	0.021	1.40 (1.35, 1.46)
Occupational position (ref. low-skilled)	0.18	0.017	1.20 (1.16, 1.24)
Subjective health status (ref. unhealthy)	− 1.19	0.029	0.30 (0.29, 0.32)

Table 2. Logistic regression analysis of factors associated with presenteeism rates. *SE* standard error, *OR* odds ratio, *CI* confidence interval. 1 USD = 1370 KRW.

Variable	Female OR (95% CI)	Male OR (95% CI)
Occupation (ref. non-healthcare worker)	1.19 (1.08, 1.32)	1.07 (0.91, 1.26)
Age	1.00 (1.00, 1.01)	1.01 (1.01, 1.01)
Years (ref. 2010)		
2011	1.10 (1.01, 1.20)	1.16 (1.07, 1.26)
2014	1.14 (1.04, 1.24)	1.27 (1.17, 1.38)
2017	0.91 (0.83, 0.99)	0.97 (0.89, 1.06)
2020	0.66 (0.59, 0.72)	0.70 (0.63, 0.77)
2023	0.19 (0.17, 0.22)	0.25 (0.22, 0.27)
Region (ref. metropolitan area)	0.81 (0.78, 0.85)	0.87 (0.84, 0.91)
Monthly income (1,000 KRW; ref. < 200)		
200–300	1.28 (1.21, 1.35)	1.22 (1.15, 1.29)
300–400	1.33 (1.24, 1.42)	1.30 (1.22, 1.38)
≥ 400	1.37 (1.29, 1.45)	1.44 (1.36, 1.52)
Occupational position (ref. high-skilled)	1.08 (1.03, 1.14)	1.31 (1.25, 1.37)
Subjective health status (ref. unhealthy)	0.30 (0.28, 0.33)	0.30 (0.28, 0.33)

Table 3. Sensitivity analysis: Sex-stratified logistic regression results for presenteeism rates. *OR* odds ratio, *CI* confidence interval. 1 USD = 1370 KRW.

need for policy reforms that address workplace health culture, particularly in essential sectors such as healthcare. These reforms should include clearer sick leave guidelines, creating an environment in which workers feel supported when staying home, and reducing the stigma associated with taking time off due to illness.

The analysis also revealed that older workers were more likely to engage in presenteeism than younger workers. This trend suggests that, as employees age, they may feel an increased sense of responsibility or pressure to attend work despite health concerns. This pattern aligns with the findings of other studies, suggesting that older workers may feel more responsible for fulfilling their work duties, particularly in leadership or skilled positions[13,14]. Older workers may also be prone to chronic health issues, which might lead them to work despite feeling unwell[14,22].

Differences in presenteeism trends between healthcare workers and the overall workforce can be attributed to several key factors related to age, job responsibilities, and the impact of the COVID-19 pandemic[23]. In healthcare, older workers (50–59 and 60 + years) often hold senior roles and face greater pressure to continue working, but their heightened vulnerability to COVID-19 may have led to a sharper decline in presenteeism post-pandemic as they became more cautious or were encouraged to take sick leave. Our findings related to age and experience do not specifically reflect the impact of managerial status. Although we were able to identify managerial positions in our dataset, managers comprised less than 1% of the total sample, so a meaningful statistical analysis by occupational hierarchy was not possible. Therefore, our findings regarding seniority relate primarily to older or more experienced workers, not necessarily those with formal management authority. In contrast, younger

healthcare workers, often in frontline roles, faced staffing shortages and physically demanding work, leading to increased presenteeism early in the pandemic[19], although it declined over time as institutions implemented changes. Meanwhile, the overall workforce likely saw less variation according to age group because of the broader and more uniform application of remote work and flexible policies[7,23,24]. Future research could delve deeper into age-related presenteeism to understand whether it stems from job insecurity, loyalty to the organization, or lack of adequate health support. Future studies should examine how both occupational hierarchy (such as managerial status) and worker seniority influence presenteeism among healthcare and non-healthcare workers. Organizations should consider tailoring workplace health policies to support aging workers, such as promoting sick leave and offering health and wellness programs for older employees.

Sex differences also emerged as a significant factor in presenteeism rates, with females consistently showing higher rates than males across both healthcare and non-healthcare workers. The logistic regression results underscored that females were 23% more likely to engage in presenteeism than males, and this pattern was especially pronounced in the healthcare sector. This finding aligns with the existing literature suggesting that female workers, particularly those in caregiving roles, face greater expectations of being present at work, even when unwell[25–28]. Among healthcare workers, the sex gap in presenteeism remained substantial throughout the study period. Female healthcare workers, who are often nurses or frontline staff, likely faced heightened pressure during the pandemic to continue working[22], driven by professional responsibilities and personal caregiving duties. The greater emotional and psychological toll on female healthcare workers, particularly during public health crises, may contribute to their higher presenteeism rates. In contrast, male healthcare workers, who may occupy more specialized or managerial roles, may not have experienced the same level of direct patient care pressure, leading to lower presenteeism rates. However, in the overall workforce, the sex gap in presenteeism narrowed more significantly during the post-pandemic period, likely due to the broader availability of remote work options for non-healthcare workers[23], which allowed women to better balance their professional and caregiving responsibilities without the need to engage in presenteeism. The pandemic-induced shift to flexible work arrangements may have eased the pressure on women among non-healthcare workers, contributing to a steeper decline in presenteeism rates for women than for healthcare workers in the overall sample. Therefore, future research should focus on understanding the underlying causes of sex-based disparities. How workplace policies, such as flexible work arrangements or improved access to paid sick leave, might help reduce the burden on female workers needs to be explored. Policy changes that support sex-sensitive work environments, such as encouraging the rest and recovery of women without the fear of job insecurity, could help mitigate presenteeism.

Our findings have important implications for both healthcare and non-healthcare workplaces. First, consistently high presenteeism rates among healthcare workers highlight the need for stronger institutional policies that prioritize workers' health and well-being. Policymakers should ensure that healthcare workers receive adequate mental health support and are encouraged to rest and recover when ill. This is especially crucial during global health crises such as pandemics. Healthcare organizations should also consider implementing more flexible sick leave policies and providing greater mental health support, particularly to female workers and older staff members. Addressing the pressures that drive presenteeism in healthcare, such as heavy workloads, emotional strain, and lack of job flexibility, is critical in promoting a healthier workforce post-pandemic.

For non-healthcare workers, the successful reduction in presenteeism after the pandemic suggests that the shift toward remote work and flexible schedules was effective. However, employers should remain vigilant in ensuring that these policies are applied equally across sex and age groups, as younger workers may still face pressures related to job security and career progression. Offering flexible work options and promoting a culture that prioritizes worker health over presenteeism are essential for sustaining these improvements.

Considering the findings of this study, implementing sex-sensitive workplace policies is necessary. Given the significant sex disparity in presenteeism, employers should develop policies that encourage women to take time off when necessary, without the fear of negative repercussions. These may include generous sick leave policies, flexible working arrangements, and improved caregiving support. In addition, organizations should implement wellness programs specifically targeting older employees, encourage them to prioritize their health, and offer incentives to take sick leave when needed. Employers could also consider flexible retirement plans or phased retirement options to reduce pressure on aging workers.

In contrast to previous studies that have focused on single occupational groups or limited time frames[13,14], this study used a large, nationally representative dataset covering a 13-year period, including the COVID-19 pandemic. Hence, this study was able to capture changes in presenteeism patterns with greater precision and to identify differences between healthcare and non-healthcare workers that have not been fully described in previous research.

Although this study provides valuable insights into presenteeism trends among healthcare and non-healthcare workers, several limitations must be acknowledged. First, the reliance on self-reported data introduces the potential for response bias, whereby workers may inaccurately report their presenteeism. Future studies could address this issue by incorporating objective data sources to validate self-reports. Additionally, combining quantitative surveys with qualitative interviews could offer a richer context and deeper insight into the reasons for presenteeism.

Second, the impact of COVID-19-related deaths among healthcare workers may lead to an underestimation of presenteeism trends by 2023. Workers who exhibited high levels of presenteeism during the pandemic may have succumbed to the virus or related complications, resulting in a potential underestimation of post-pandemic presenteeism rates.

Third, the study did not capture organizational factors, such as sick leave policies, mental health support, or burnout prevention programs, that are likely to influence presenteeism. Future research should include data on workplace policies and use multilevel modeling to explore how these institutional factors interact with

individual-level characteristics such as age and sex, offering a more comprehensive understanding of the drivers of presenteeism.

Fourth, the findings were based on data from South Korea, limiting their generalizability to other cultural or healthcare contexts. Future studies could conduct cross-cultural comparisons by analyzing presenteeism trends in different countries, particularly in those with flexible work environments or different healthcare infrastructures. This will allow for a broader understanding of how cultural and institutional differences shape presenteeism. By addressing these limitations and incorporating more robust data collection and analysis methods, future research can provide a more comprehensive understanding of presenteeism dynamics in both healthcare and non-healthcare settings.

In addition, sex was analyzed as a binary variable (male/female), based on the available KWCS data. We recognize that gender identity is more diverse, and future surveys should consider including non-binary and other gender categories to better capture the experiences of all workers.

Finally, although the temporal decline in presenteeism rates overlapped with the period of COVID-19 pandemic, of note, the KWCS survey did not directly measure the impact of the pandemic or collect data on COVID-19-related changes in the workplace. Therefore, although we observed notable shifts in presenteeism during and after the pandemic period, these trends cannot be attributed solely to COVID-19. Other factors, such as changes in workplace policies, economic conditions, or increasing public awareness of health issues, may have also influenced these patterns. Further research that incorporates more detailed, pandemic-specific measures is needed to clarify these relationships.

In conclusion, this study highlights significant differences in presenteeism trends between healthcare and non-healthcare workers in South Korea from 2010 to 2023, with healthcare workers showing a higher likelihood of working ineffectively, especially during the COVID-19 pandemic. Age and sex played key roles, with older workers and females experiencing higher rates of presenteeism. These findings emphasize the need for stronger workplace policies, including gender-sensitive measures, mental health support, and more flexible sick leave options, to reduce presenteeism, especially in essential sectors such as healthcare. Our findings can contribute to a broader understanding of presenteeism and may inform future research and workplace strategies. Future research should address organizational factors and conduct cross-cultural comparisons to better understand the drivers of presenteeism and inform targeted interventions.

Data availability

Data supporting the findings of this study are available at https://oshri.kosha.or.kr/oshri/researchField/workingEnvironmentSurvey.do.

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Author contributions

A.M. and W.B. conceptualized and planned the study design. WB handled the data. A.M. and W.B. analyzed and interpreted the data. A.M., W.B. and Y.J. drafted the manuscript. All authors have reviewed the manuscript and approved the final version for publication.

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Declarations

Competing interests

The authors declare no conflicts of interest regarding the publication of this paper.

Additional information

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