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Original article

Association Between Sickness Presenteeism and Depressive Symptoms by Occupation and Employment Type During the COVID-19 Pandemic

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ABSTRACT

Background: Sickness presenteeism (SP) has gained attention in occupational health. This study aimed to analyze the relationship between SP and depressive symptoms by occupation and employment type during the COVID-19 pandemic in Korea.

Methods: Community Health Survey data (August 16 to October 31, 2020–2021) were used to assess depressive symptoms and SP among workers (n = 221,241; mean age 46.0; 53.5% male). Depressive symptoms were measured using the Patient Health Questionnaire-9, and SP was defined by the ability to rest at home when exhibiting COVID-19 symptoms. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) of depressive symptoms were estimated using multiple logistic regression analyses for each sex and year stratum. The interaction between SP and occupation on depressive symptoms was assessed using relative excess risk due to interaction (RERI).

Results: The prevalence of depressive symptoms was higher in individuals with SP than in those without SP (4.22% [n = 696] vs. 1.89% [n = 3861], respectively). After adjusting for demographic and occupational variables, the association between SP and depressive symptoms was significant in both sexes in 2020 and 2021 (OR [95% CI]: 2.18 [1.82–2.62], 2.41 [1.97–2.93], 2.05 [1.77–2.38], 2.47 [2.11–2.88] for male–2020, male–2021, female–2020, and female–2021, respectively). A marginally significant interaction between service workers and SP on depressive symptoms was observed among male workers in 2021 (RERI = 2.37, 95% CI = [−0.04–4.78]) but not in other strata.

Conclusion: SP is significantly associated with depressive symptoms in Korean workers across employment and occupational types, with a prominent association in service workers.

1. Introduction

Sickness presenteeism (SP) has rapidly gained attention in the occupational health field [1] and is defined as “the phenomenon of people, despite complaints and ill health that should prompt rest and absence from work, still turning up at their jobs” [2]. SP can have a detrimental impact on productivity, and the inability to perform at one’s best due to illness, disability, or premature death results in societal costs [3].

During the COVID-19 pandemic, many businesses faced economic crises and sought to minimize expenses related to sickness absenteeism to maintain productivity and profits, which might have led to increased SP costs [4]. The increased costs associated with the rise in SP during the COVID-19 pandemic may be

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correlated with the deteriorating health of individuals due to SP. SP can have adverse effects on the physical and mental health of individual workers [5]. Kivimaki [6] found that SP is associated with an increased risk of serious cardiac events among unhealthy and distressed employees. Furthermore, SP is an independent predictor of future poor self-rated health [7], whereas self-rated health predicts the risk of future depression [8]. It has also been known as a risk factor for burnout [9], which is associated with depression.

Comorbidities between depression and various chronic diseases are associated with decreased overall health. A study of the comorbidity of depression and several prevalent chronic diseases, including angina, arthritis, asthma, and diabetes, in relation to a decline in self-reported health, found that comorbid depression progressively exacerbated health deterioration compared to instances of depression in isolation, any individual chronic disease in isolation, or any combination of chronic diseases in the absence of depression [10]. Therefore, from the perspective of depression, the increase of SP during the COVID-19 pandemic may be associated with a decline in the health status of individuals who are concurrently managing chronic diseases.

While mounting research has examined the relationship between SP and depression, studies on Korean workers' SP amid the COVID-19 pandemic are limited. Although a cross-sectional study regarding SP and depressive symptoms in Korean workers [11] has been conducted, it covered the year 2020; meanwhile, the impact of the COVID-19 pandemic was also present in 2021. Additionally, workplace atmosphere can be related to SP, meaning some occupations could have experienced increased vulnerability to SP during the COVID-19 pandemic, which could be associated with increased depressive symptoms among workers of specific occupations. Therefore, in this study, we aimed to examine whether the association between depressive symptoms and SP is higher in specific occupation and type of employment.

2. Materials and methods

2.1. Data and participants

This study utilized data from the Community Health Survey (CHS) for the years 2020 and 2021. The CHS is an annual, cross-sectional survey that has been conducted by the Korea Centers for Disease Control and Prevention since 2008 [12]. The survey targeted individuals in the Republic of Korea who were 18 years of age and older and stratified them by the provinces and metropolitan cities [13]. The CHS used a multistage sampling design. Trained interviewers visited selected households to collect information valuable for planning, implementing, monitoring, and evaluating community health initiatives. Both the 2020 and 2021 editions of the CHS were conducted from August 16 to October 31 of each year.

We applied the following criteria to extract samples from the raw data: 1) included only employed individuals without professional military workers; 2) excluded individuals aged over 64; and 3) excluded individuals who did not respond appropriately to questions relevant to this study, such as those regarding depressive symptoms. The final sample size of 221,241 was obtained from a population of 458,511 individuals who participated in the survey in 2020 or 2021 (Fig. 1).

2.2. Main variables

We utilized the Patient Health Questionnaire-9 (PHQ-9) score to assess the presence of depressive symptoms in individuals. The PHQ-9 is a self-assessment questionnaire comprising nine items used to measure depressive symptoms. Although it is not a diagnostic tool for depression, the questionnaire has demonstrated

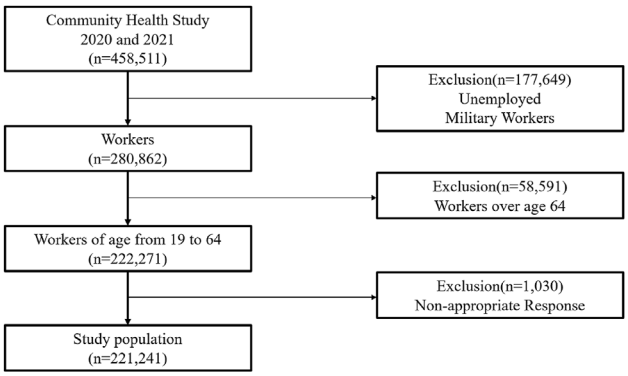

Fig. 1. Extraction of study population from raw data.

good validity and reliability [14,15] and has been utilized in previous studies [16–18]. Each item on the PHQ-9 is rated on a 4-point scale, with scores ranging from 0 (*not at all*) to 3 (*nearly every day*), with higher scores indicating more frequent symptom occurrence. The total PHQ-9 scores can range from 0 to 27, with higher total scores indicating greater overall severity of symptoms [19]. In this study, the presence of clinically meaningful depressive symptoms was determined by a PHQ-9 score of greater than or equal to 10 [16].

Those who could not rest at home when experiencing COVID-19-like symptoms such as fever or a cough were defined as individuals exhibiting SP. Both the CHS in 2020 and 2021 included the question "Can you rest at home when you have a fever or respiratory symptoms such as coughing?" Participants who responded "no" were regarded as workers with SP.

2.3. Covariates

The CHS questionnaire included the following variables: age, sex (male/female), educational status (revised to college and less than college), occupation (revised to manager, professional and officer, service, sales, and manual workers for machine operators, craft workers, or assemblers) [20], employment type (employee, employer, or self-employed), and marital status (married, widowed/divorced, and unmarried).

2.4. Statistical analysis

The relationships between demographic and occupational variables and the presence of clinically meaningful depressive symptoms were explored using chi-square tests. The complete dataset was divided first by sex and further by year of participation. Separate chi-square tests were performed on each of these datasets. All analyses were conducted with four divided datasets stratified by sex and year from the entire dataset.

Multiple logistic regression analysis was used to examine the statistical significance of the association between SP and depressive symptoms after adjusting for the influence of all other variables. Three logistic regression models were constructed. The first was a univariate model that only included SP. Adjustments for age, occupation, and employment type were incorporated in the second model. Additional adjustments for education and marital status were added in the third model.

Subgroup analysis was conducted to evaluate the associations between SP and depressive symptoms for each occupational group and employment type. After stratifying the four subgroups by employment type, logistic regression analyses were conducted in

each subgroup. The same procedure was followed, after stratifying the four subgroups by occupation.

Finally, interaction analysis was conducted to check the presence of statistically significant interactions between occupation and SP. Professional and office workers were set as the reference groups, compared with service workers. Age, employment type, education status, and marital status were covariates in the logistic regression model. The relative excess risk due to interaction (RERI) was used to examine the significance of the interaction.

Sensitivity analyses were performed using an additional question in the CHS data exclusively in the year 2020 (i.e., "What is the primary reason for not staying at home when feeling unwell?"). This process was conducted to validate our definition of SP. Responses included a) inability to take sick leave from work, b) necessity to purchase essential items, c) responsibility for the care of separated family members or acquaintances, and d) other reasons. Those who selected a) "Cannot take sick leave from work" as their response to the additional question were redefined as individuals with SP in 2020. Using this definition, multiple logistic regression analyses were performed with the data on workers in the year 2020, using the same methodology outlined previously.

Analysis results with *p*-values of 0.05 or less and a 95% confidence interval (CI) not containing 1 for the odds ratio were considered significant. All analyses were performed through R 4.2.1.

2.5. Ethics statement

This study received permission from the Korea Disease Control and Prevention Agency before conducting the analyses. The CHS is approved by the statistical department. Data were anonymized before being obtained from the Korea Disease Control and Prevention Agency. All participants signed an informed-consent form. The institutional review board (IRB) of Severance Hospital, Yonsei University, approved this study (IRB number: 4-2023-0971).

3. Results

Among the study participants (mean age: 46.0; male: 53.5%), the prevalence of depressive symptoms and SP was 2.06% (n = 4,557) and 7.45% (n = 16,481), respectively. The prevalence of depressive symptoms was higher in individuals with SP than in those without SP (4.22% [n = 696] vs. 1.89% [n = 3,861], respectively). The prevalence of depressive symptoms was also higher among workers with SP than in workers without SP in all four distinct datasets (i.e., male in 2020, male in 2021, female in 2020, and female in 2021; Table 1). Also, the prevalance of depressive symptoms was overally higher in 2021 than in 2020 (2.20% [n = 2459] vs. 1.91% [n = 2,098], respectively).

After adjusting for covariates (age, occupation, employment type, education status, marital status) higher odds ratios (ORs) of depressive symptoms were observed among individuals with SP than in those without SP in all the four subgroups (male-2020: OR = 2.18, 95% CI = [1.82–2.62]; male-2021: OR = 2.41, 95% CI = [1.97–2.93]; female-2020: OR = 2.05, 95% CI = [1.77–2.38]; female-2021: OR = 2.47, 95% CI = [2.11–2.88]; Table 2).

After stratifying by employment type, the association between depressive symptoms and SP was significant for all employment types in 2020 and 2021 for both sexes (Tables 3 and 4). For male participants in 2020, SP was significantly associated with depressive symptoms in individuals for all occupation types. For male participants in 2021, the same pattern was observed for all occupation types except for managers. Furthermore, the OR of depressive symptoms by SP among service workers was the highest (OR = 4.16, 95% CI: [2.51–6.90]). For 2020 and 2021 female

Table 2
Association between presence of depressive symptoms and SP after adjusting covariates

Sex	Year	Model	SP	
			No	Yes
Male	2020	Model I	*1.00*	2.26 (1.88–2.70)
		Model II	*1.00*	2.23 (1.86–2.67)
		Model III	*1.00*	2.18 (1.82–2.62)
	2021	Model I	*1.00*	2.46 (2.02–3.00)
		Model II	*1.00*	2.43 (2.00–2.96)
		Model III	*1.00*	2.41 (1.97–2.93)
Female	2020	Model I	*1.00*	2.19 (1.89–2.54)
		Model II	*1.00*	2.16 (1.86–2.50)
		Model III	*1.00*	2.05 (1.77–2.38)
	2021	Model I	*1.00*	2.50 (2.14–2.91)
		Model II	*1.00*	2.46 (2.11–2.86)
		Model III	*1.00*	2.47 (2.11–2.88)

Model I: Univariate model with only SP.
Model II: Multivariate model with SP, age, occupation, and employment type.
Model III: Multivariate model with SP, age, occupation, employment type, education, and marital status.
Abbreviation: SP, sickness presenteeism.

Table 1
Basic characteristics and the prevalence of depressive symptoms among study participants

Age	Sex	Male (n = 118,411)		Female (n = 102,830)	
	Year	2020 (n = 58,863)	2021 (n = 59,548)	2020 (n = 50,581)	2021 (n = 52,249)
	Mean (standard deviation)	46.2 (11.6)	46.1 (11.6)	45.8 (12.2)	45.7 (12.2)
Variables	Values	n (%)	n (%)	n (%)	n (%)
SP	No	53,461 (1.2)	56,268 (1.5)	45,957 (2.3)	49,074 (2.6)
	Yes	5402 (2.7)	3280 (3.6)	4624 (4.9)	3175 (6.4)
Occupation	Officer	18,287 (1.3)	19,328 (1.5)	20,277 (2.5)	22,164 (3.0)
	Manager	2512 (1.4)	2996 (1.4)	649 (2.3)	843 (2.7)
	Service	4329 (1.9)	4222 (2.4)	10,469 (3.1)	10,264 (3.2)
	Sales	4999 (1.8)	4760 (1.7)	5897 (3.1)	5806 (2.8)
	Manual	28,736 (1.3)	28,242 (1.6)	13,289 (2.1)	13,172 (2.3)
Employment type	Employee	39,666 (1.4)	40,666 (1.6)	36,727 (2.6)	38,094 (2.9)
	Employer or self-employed workers	19,197 (1.3)	18,882 (1.5)	13,854 (2.4)	14,155 (2.7)
Education	College	28,991 (1.2)	30,741 (1.4)	21,893 (2.6)	24,258 (2.9)
	Less than college	29,872 (1.5)	28,807 (1.8)	28,688 (2.5)	27,991 (2.9)
Marital status	Married	41,373 (1.1)	41,658 (1.2)	34,551 (1.8)	35,894 (2.1)
	Unmarried	14,156 (2.2)	14,479 (2.5)	10,552 (4.4)	10,948 (5.0)
	Widowed/divorced	3334 (1.8)	3411 (2.6)	5478 (3.4)	5407 (3.8)

The percentage number within parentheses represents the prevalence of depressive symptoms among each subgroup.
Abbreviation: SP, sickness presenteeism.

Table 3
Stratification by employment type

Employment type			Employee		Employer or self-employed	
Sex	Year	Depressive symptoms	SP		SP	
			No	Yes	No	Yes
Male	2020	Yes	446 (1.2%)	112 (3.0%)	213 (1.2%)	36 (2.2%)
		No	35,473 (98.8%)	3635 (97.0%)	17,329 (98.8%)	1619 (97.8%)
		OR (95% CI)	*1.00*	2.45 (1.98–3.03)	*1.00*	1.70 (1.18–2.44)
	2021	Yes	581 (1.5%)	86 (3.9%)	259 (1.5%)	32 (2.9%)
		No	37,907 (98.5%)	2092 (96.1%)	17,521 (98.5%)	1070 (97.1%)
		OR (95% CI)	*1.00*	2.73 (2.16–3.44)	*1.00*	1.93 (1.33–2.82)
Female	2020	Yes	771 (2.3%)	181 (5.0%)	292 (2.3%)	47 (4.7%)
		No	32,327 (97.7%)	3448 (95.0%)	12,567 (97.7%)	948 (95.3%)
		OR (95% CI)	*1.00*	2.10 (1.78–2.48)	*1.00*	1.90 (1.38–2.61)
	2021	Yes	966 (2.7%)	157 (6.3%)	333 (2.5%)	45 (6.4%)
		No	34,652 (97.3%)	2319 (93.7%)	13,123 (97.5%)	654 (93.6%)
		OR (95% CI)	*1.00*	2.49 (2.09–2.97)	*1.00*	2.48 (1.79–3.43)

Abbreviations: CI, confidence interval; OR, odds ratio; SP, sickness presenteeism.

participants, the association between depressive symptoms and SP was significant for all occupation types except managers.

The results of RERI indicated a marginally significant interaction effect of SP and occupation on depressive symptoms only among male participants in 2021 (RERI = 2.37, 95% CI: [−0.04–4.78]; Table 5). No statistically significant interactions were found in the other three subgroups [21,22].

The sensitivity analysis was consistent with the results presented in Table 2, with males in 2020 displaying an OR of 2.22 (95% CI: [1.84–2.67]) and females in 2020 exhibiting an OR of 2.08 (95% CI: [1.78–2.42]; Table S1).

4. Discussion

This study analyzed data to check the association of depressive symptoms with SP based on occupation and employment type. The ORs for depressive symptoms were higher in individuals with SP after adjusting for demographic and occupational variables. After dividing the data into subgroups by occupation and employment type, the association of depressive symptoms with SP in individuals unable to take sick leave was not weaker than that in those without SP. Although the interaction effect of occupation and SP on depressive symptoms in 2020 was not significant, a marginally significant interaction for male service workers was observed in 2021. The statistical significance of the interaction effect was likely near the significance threshold.

One way to understand the association between SP and depressive symptoms is to divide it into two distinct steps. The first step is the association between SP and chronic stress. The second step is the impact of chronic stress on the development of depressive symptoms. SP is related to working with physical discomfort. In a previous cross-sectional study by YH Lin et al. [23], physical discomfort (e.g., sore throat, chronic cough with congestion, and musculoskeletal discomfort) was associated with increased job stress [23]. Some occupational factors are associated with SP and chronic stress. For example, research has indicated factors contributing to SP among healthcare workers may include fear of letting colleagues down and losing their respect, and pressure to present a picture of good health [24,25]. These factors are not restricted to healthcare workers since service workers must also hide their emotions, which is related to portraying a healthy image. Such behavior can result in a discrepancy between the worker's actual emotion and the requested emotional state, contributing to chronic psychological stress [26,27].

While individual coping mechanisms for stress may vary, Tafet and Nemeroff [28] revealed that dysfunctional cognitive schemas tend to be activated in response to stressful situations in adulthood. This activation can result in biases during information processing, leading to various dysfunctional effects, including cognitive processing, emotional reactions, and behavioral responses. According to the hopelessness theory of depression [29], certain individuals exhibit a cognitive vulnerability that interacts with stressful life events, increasing the likelihood of depression [30]. The theory identifies cognitive vulnerability as an individual's inclination to draw specific types of conclusions concerning the origins, ramifications, and implications for self-esteem due to stressful life events [30]. Specifically, individuals with this cognitive vulnerability tend to attribute such events to stable and global causes, viewing the event as likely to lead to other negative consequences and interpreting the event as a product of their poor ability [30,31]. Those who reach such conclusions are hypothesized to be at risk for hopelessness, which is regarded as an immediate and adequate precursor to depression [30]. Consequently, an increased susceptibility to stress serves as a factor for cognitive vulnerability, contributing to the onset of depression.

In 2020, many people worldwide worked from home. For some occupational groups, taking sick leave is challenging due to the nature of their responsibilities or their indispensability in the workplace. One study by Marciniak-Nuqui et al. [32] reported that NHS staff perceived staying home when unwell as acceptable, primarily because they could fulfill some responsibilities remotely, maintaining their work continuity and avoiding letting down colleagues and patients [32]. In our study, we defined individuals without SP as those who were able to rest at home when experiencing fever or respiratory symptoms, potentially including those who worked remotely while sick in our SP group. The decrease in Korea's stringency index [33] from 2020 to 2021 indicated a relaxation of quarantine policies in 2021 compared to the previous year. The stringency index, calculated in the Oxford Coronavirus Government Response Tracker, assesses the severity of quarantine measures based on nine scaled indicators. These indicators encompass containment and closure policies, along with an indicator of public information campaigns [34]. A higher index indicates a greater stringency in the government's response. Consequently, more workers were likely to work in a face-to-face environment. Furthermore, it is plausible that even if a worker exhibited symptoms of COVID-19, without being tested or testing negative for the virus, they could engage in SP without going into quarantine. Being in the workplace while ill could increase the burden on workers compared to working from home while ill. These differences in SP behaviors could be related to the association between SP and depressive symptoms.

One reason behind the interaction between SP and occupation in male employees could be an increase in the intensity of

Table 4
Stratification by occupation

Sex	Year	Depressive symptoms	Officer		Manager		Service		Sales		Manual	
			SP		SP		SP		SP		SP	
			No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Male	2020	Yes	189 (1.1%)	45 (3.0%)	24 (1.0%)	10 (4.5%)	69 (1.8%)	15 (3.8%)	70 (1.6%)	19 (3.1%)	307 (1.2%)	59 (2.2%)
		No	16,586 (98.9%)	1467 (97.0%)	2265 (99.0%)	213 (95.5%)	3860 (98.2%)	385 (96.2%)	4320 (98.4%)	590 (96.9%)	25,771 (98.8%)	2599 (97.8%)
		OR (95% CI)	*1.00*	2.59 (1.86–3.61)	*1.00*	3.58 (1.66–7.63)	*1.00*	2.31 (1.30–4.10)	*1.00*	2.03 (1.21–3.40)	*1.00*	1.88 (1.42–2.50)
	2021	Yes	260 (1.4%)	26 (3.2%)	41 (1.4%)	2 (1.7%)	81 (2.1%)	21 (7.6%)	66 (1.5%)	16 (4.5%)	392 (1.5%)	53 (3.1%)
		No	18,260 (98.6%)	782 (96.8%)	2835 (98.6%)	118 (98.3%)	3866 (97.9%)	254 (92.4%)	4340 (98.5%)	338 (95.5%)	26,127 (98.5%)	1670 (96.9%)
		OR (95% CI)	*1.00*	2.34 (1.55–3.53)	*1.00*	1.06 (0.25–4.50)	*1.00*	4.16 (2.51–6.90)	*1.00*	3.00 (1.71–5.26)	*1.00*	2.14 (1.60–2.87)
Female	2020	Yes	393 (2.2%)	105 (4.9%)	11 (1.9%)	4 (6.0%)	269 (2.8%)	53 (5.5%)	148 (2.8%)	32 (5.6%)	242 (1.9%)	34 (3.9%)
		No	17,746 (97.8%)	2033 (95.1%)	571 (98.1%)	63 (94.0%)	9231 (97.2%)	916 (94.5%)	5174 (97.2%)	543 (94.4%)	12,172 (98.1%)	841 (96.1%)
		OR (95% CI)	*1.00*	2.17 (1.74–2.71)	*1.00*	2.79 (0.83–9.41)	*1.00*	1.96 (1.44–2.66)	*1.00*	2.02 (1.36–2.99)	*1.00*	1.86 (1.28–2.69)
	2021	Yes	579 (2.8%)	94 (6.4%)	20 (2.5%)	3 (5.8%)	287 (3.0%)	45 (6.5%)	140 (2.6%)	25 (7.4%)	273 (2.2%)	35 (5.7%)
		No	20,116 (97.2%)	1375 (93.6%)	771 (97.5%)	49 (94.2%)	9282 (97.0%)	650 (93.5%)	5326 (97.4%)	315 (92.6%)	12,280 (97.8%)	584 (94.3%)
		OR (95% CI)	*1.00*	2.41 (1.92–3.02)	*1.00*	2.24 (0.64–7.87)	*1.00*	2.32 (1.67–3.22)	*1.00*	3.23 (2.06–5.05)	*1.00*	2.52 (1.74–3.64)

Abbreviations: CI, confidence interval; OR, odds ratio; SP, sickness presenteeism.

emotional labor in 2021. Jung [35] found that participants who always or sometimes hide their emotions in the workplace have a higher risk for SP. Hiding emotions can increase the risk of sleep disorders and insomnia in workers. The risk of SP is higher among patients with these types of disorders [36,37]. An increased number of service workers began to work face-to-face in 2021, although restrictions to curb the spread of COVID-19 remained. These restrictions in the workplace hindered service workers from engaging in effective emotional labor and disrupted high-quality communication and interactions between service employees and customers [38]. Furthermore, the adverse effects of customer mistreatment on service employees worsened during the COVID-19 pandemic [39], which could be related to the increase of work-related stress among service workers. Workers with less work-related stress are less likely to experience SP [40]. Work-related stress is related to emotional exhaustion, negatively affecting productivity loss due to SP [41]. A study conducted by Price et al. [42] indicated that being male is a significant predictor of emotional exhaustion. In our study, the interaction between SP and occupation was more distinct in males than in females, supporting previous findings of this interaction being more severe in male service groups in 2021.

Job insecurity could be another reason for the presence of a relative increased risk for depression due to the interaction between SP and employment type in service workers. According to Zhang et al. [43], job insecurity significantly predicted nurses' SP behavior. Similarly, Jeon et al.'s study [44] reported that perceived job insecurity potentially compelled workers to report to work when sick. Service employees faced an increased level of job insecurity amid the COVID-19 pandemic, which can be associated with the possibility of increased SP behavior of service workers [38]. Fear of losing employment and poverty contributed to workers believing they have no choice but to work with poor physical health [45]. Their autonomy in their workplace had decreased, resulting in lower job control. A previous study investigated the moderating effect of job control on the association between high emotional demand and depressive mood in service workers and found significant moderation only among male workers [46], aligning with our results. Thus, high emotional demand may adversely affect male workers' mood in the context of the degree of job autonomy [46]. The Job Demand-Control model, a theoretical framework for understanding mental strain in the workplace, posits that the interaction between high psychological job demand and low job control can have deleterious consequences on workers' mental health [47]. One reason for low job control could be direct supervisors' behavior. A previous study by Lee et al. [48] found that the association between direct supervisor's behavior and employee presenteeism was significant in male but not in female workers, further supporting our current findings.

4.1. Strength and limitations

Limited research has analyzed the association between depressive symptoms and SP in specific occupational subgroups and different employment types. Therefore, this study focused on the association between SP and depressive symptoms in workers with different occupations and employment types. We found that SP is a significant factor for depressive symptoms in most occupational groups for both males and females. We also found that a positive interaction between SP and occupation could exist. Finally, our findings can be generalized to the wider population of the Republic of Korea because a large, nationally representative dataset from the CHS was used.

Our study has some limitations. First, we only analyzed data from the Republic of Korea, which may not be generalizable to other countries or cultures. Second, the item used to define SP in

Table 5
Interaction between occupation and sickness presenteeism with odds ratio and 95% confidence interval of depressive symptoms

Sex	Year	Occupation	SP				
			No	Yes	Effect of SP within the strata of occupation	Multiplicative scale	RERI
Male	2020	Officer	1.00	2.62 (1.88- 3.65)	2.62 (1.88- 3.65)	0.85 (0.44−1.65)	−0.13 (−1.78− 1.51)
		Service	1.20 (0.89−1.63)	2.69 (1.55- 4.68)	2.24 (1.26- 3.96)		
		Effect of occupation within the strata of SP	1.20 (0.89−1.63)	1.03 (0.56−1.89)			
	2021	Officer	1.00	2.33 (1.55−3.52)	2.33 (1.55−3.52)	1.83 (0.96−3.50)	2.37 (−0.04− 4.78)
		Service	1.13 (0.86−1.49)	4.83 (2.99−7.80)	4.27 (2.59- 7.05)		
		Effect of occupation within the strata of SP	1.13 (0.86−1.49)	2.07 (1.13- 3.80)			
Female	2020	Officer	1.00	2.19 (1.75−2.73)	2.19 (1.75−2.73)	0.90 (0.62−1.31)	0.20 (−0.73− 1.13)
		Service	1.44 (1.20−1.72)	2.83 (2.07−3.86)	1.97 (1.45−2.67)		
		Effect of occupation within the strata of SP	1.44 (1.20−1.72)	1.29 (0.91−1.84)			
	2021	Officer	1.00	2.39 (1.91−3.00)	2.39 (1.91−3.00)	0.98 (0.66−1.45)	−0.03 (−0.93− 0.88)
		Service	1.02 (0.87−1.21)	2.39 (1.72−3.32)	2.33 (1.68−3.24)		
		Effect of occupation within the strata of SP	1.02 (0.87−1.21)	1.00 (0.68−1.46)			

Abbreviations: CI, confidence interval; OR, odds ratio; RERI; relative excess risk due to interaction; SP, sickness presenteeism.

our study might not precisely mirror the broader conceptualization of SP used in other studies, primarily since it does not explicitly inquire about circumstances where employees are expected to work at their designated workplace despite exhibiting clinical respiratory symptoms. We conducted additional analysis using an extra question from the CHS questionnaire of 2020 to overcome this limitation, yielding results consistent with those of the present study. Moreover, in 2020, work-related factors were identified by 92% of individuals who reported that they could not rest at home while exhibiting COVID-19-like symptoms, underscoring the importance of occupational responsibilities as the main cause of SP. Third, only broad categories for occupation were used in the CHS survey as insufficient information about the various subcategories of service workers is available. Finally, causality was insufficient because of the use of cross-sectional data covering 2020 and 2021.

5. Conclusion

This study investigated the association between SP and depressive symptoms by occupation and employment type in 2020 and 2021. The association between SP and depressive symptoms was significant for most subgroups that had enough participants. Compared to 2020, interaction between occupation and SP on depressive symptoms among male participants was observed in 2021, and service workers were more vulnerable to SP than office workers. In contexts similar to the COVID-19 pandemic, appropriate strategies at the organizational or government level should be implemented to prevent workers of specific occupational groups from SP-related depressive symptoms.

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CRediT authorship contribution statement

Minkoo Kang: Writing—review and editing, Writing—original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Won-Tae Lee:** Writing—review and editing, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Byungyoon Yun:** Writing—review and editing, Validation, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Jin-Ha Yoon:** Supervision, Methodology, Conceptualization.

Conflicts of interest

The authors have no conflict of interest to report.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.shaw.2024.06.002.

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