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Original article

Association Between Organizational Downsizing and Depressive Symptoms Among Korean Workers: A Cross-sectional Analysis

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ABSTRACT

Background: Organizational downsizing may be significantly linked to depressive symptoms, yet research on this impact in Asian contexts is limited. This study investigates the association between downsizing during the COVID-19 pandemic and depressive symptoms across diverse employment statuses.

Methods: This study used the data from 6th Korean Working Conditions Survey. Depressive symptoms were measured using WHO-5 well-being index with a cut-off of 50. Downsizing was defined as decrease in the number of employees during last three years. Multivariable logistic regression adjusted for socio-demographic and occupational factors was used to estimate the adjusted odds ratio (OR) and 95% confidence interval (CI) for depressive symptoms associated with downsizing, including subgroup analyses.

Results: Among 26,247 Korean workers (mean age: 43.4, men: 47.5%), the prevalence of depressive symptoms was 29.5% ($n = 7,751$), and the proportion of downsizing was 15.2% ($n = 3,978$). The prevalence of depressive symptoms was significantly higher among the downsizing group (36.7%, $n = 1,460$) than among the no-downsizing group (28.3%, $n = 6,291$). The result of logistic regression revealed a significant association between downsizing and depressive symptoms (adjusted OR [95% CI]: 1.39 [1.29–1.50]), particularly pronounced among high socioeconomic status workers.

Conclusion: This study underscores the significant association between depressive symptoms and organizational downsizing, especially high vulnerability of socioeconomically advantaged and stable workers. These findings highlight the necessity for targeted mental health support and further longitudinal research to clarify the relationship between employment changes and mental health within the Korean workforce.

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1. Introduction

Depression is a common mental disorder characterized by a multifaceted symptomatology, encompassing emotional, cognitive, and physiological domains [1]. The World Health Organization (WHO) highlights depression as the leading cause of disability

worldwide, with a staggering connection to over 8 million suicides annually [2]. According to Lim et al. [3], the lifetime prevalence of depression was reported at 10.8% from 1994 to 2014. Moreover, during the COVID-19 pandemic, the prevalence of depression increased worldwide [4].

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Abbreviations: KWCS, Korean Working Conditions Survey; OR, odds ratio; CI, confidence interval.

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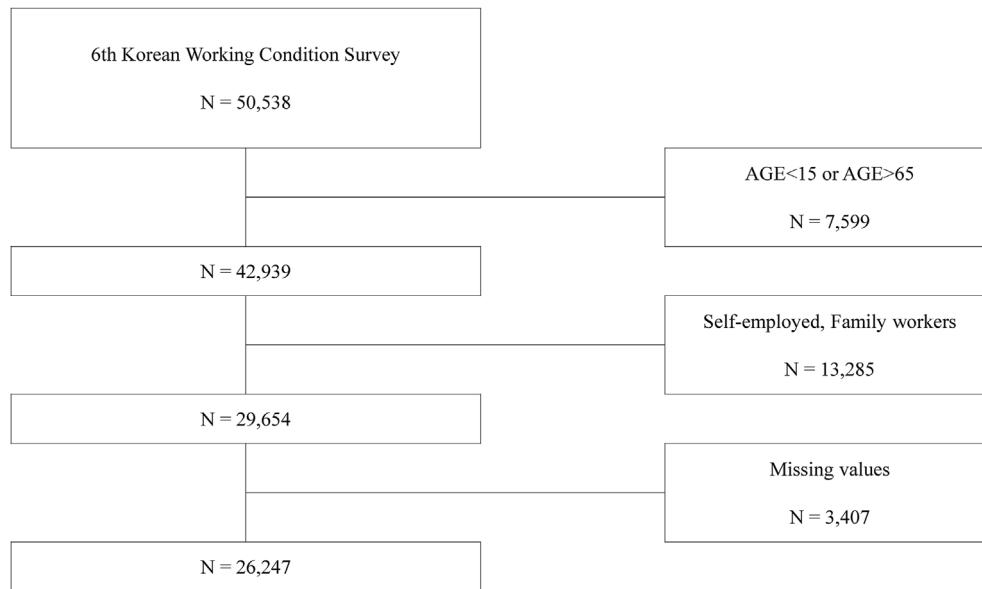


Fig. 1. Study population inclusion process.

In the context of occupational perspectives, depression can also cause significant burdens for society [5]. In Australia, annual losses in productivity attributed to depression have been estimated to cost employers approximately 8 billion Australian dollars annually [6]. Depressive symptoms negatively affect individual workers and organizations [7]. Previous studies have delineated an association between depression and compromised labor productivity, including increased occurrences of absenteeism [8] and sick leave [9], higher medical expenses for employers [6], and decreased job satisfaction among workers [10]. Factors associated with depressive symptoms in workers have been identified; they include job insecurity [11], number of employees at workplaces [12], working hours, and effort–reward imbalance [13]. Additionally, the occurrence of layoffs, which is a common consequence of organizational downsizing [14], has been recognized as a significant risk factor for depressive symptoms among workers.

Downsizing is defined as the purposeful reduction in the size of an organization, implying the planned elimination of jobs [15]. It is deployed in various contexts, including economic downturn [15–18], changes in governmental policies [17], adoption of new technological advancements such as artificial intelligence and robotics automation [16,17,19], and initiatives for organizational innovation not related to financial difficulties [18].

Downsizing negatively affects workers' working conditions and well-being [20]. Moreover, downsizing is correlated with the occurrence of depressive symptoms in workers [21]. Previous studies have identified the concept of “survivor syndrome,” which is characterized by changed attitudes, emotions, and perceptions among those who remain after organizational downsizing [22].

Brenner et al. [23] and Frone et al. [20] identified a correlation between depressive symptoms and downsizing in Europe and the U.S. Although extensive studies have explored the relationship between employee depression and downsizing in Western contexts, there is a significant deficiency in studies conducted in Asian and Korean contexts. A recent study conducted in Bangladesh in 2022 investigated the significant correlation between downsizing and depressive symptoms within the context of the COVID-19 pandemic [24]. However, this investigation primarily focused on individuals employed in the private sector and did not include an analysis segmented by socioeconomic occupational characteristics, such as occupational classification and employment status.

Addressing this gap, the present study aims to investigate the relationship between downsizing and depressive symptoms among Korean workers, with a particular emphasis on incorporating a diverse range of occupational characteristics to offer deeper insights into the effects of downsizing.

2. Methods

2.1. Data collection and study design

This study used data collected from the 6th Korean Working Conditions Survey (KWCS) conducted by the Korean Occupational Safety and Health Research Institute from October 2020 to April 2021.

The survey is based on the European Working Conditions Survey; it is administered every three years and targets workers aged over 15 years. It comprises over 130 questions about employee characteristics, such as sex, age, occupation, and employment status, and aspects of the working environment. KWCS data collection was conducted through in-person, one-on-one interviews with a professional interviewer. The KWCS sample was determined using a secondary probability proportion-stratified cluster sample survey with guaranteed reliability [25].

In total, 50,538 individuals were surveyed. However, participants aged <15 or >65 years ($n = 7,599$), those who were self-employed or family workers ($n = 13,285$), and those with missing values ($n = 3,407$) were excluded. Thus, 26,247 workers were included in this study (Fig. 1).

2.2. Outcomes and independent variables

To assess downsizing, participants were asked, “During the last three years (or since you started your job), has the number of employees at your workplace increased, stayed the same, or decreased?” Responses of “increased a lot,” “increased a little,” or “no change” were classified as “no downsizing;” responses of “decreased a lot” or “decreased a little” were classified as downsizing [26].

Depressive symptoms were assessed using the WHO-5 Well-being Index. This index comprises five items and is a widely adopted assessment of subjective wellbeing. It is a useful tool for

identifying depressive symptoms and has strong internal and external validity [27]. Participants were asked to rate the following five statements according to how they felt during the last two weeks: “I have felt cheerful and in good spirits,” “I have felt calm and relaxed,” “I have felt active and vigorous,” “I woke up feeling fresh and rested,” and “My daily life has been filled with things that interest me.” Responses were graded on a scale of 5 (“all of the time”) to 0 (“at no time”). The raw score was multiplied by 4, obtaining a total score ranging from 0 (absence of well-being) to 100 (maximum wellbeing).

Previous studies have indicated that the index exhibits a sensitivity of 0.86 and a specificity of 0.81 in relation to the diagnostic and statistical manual of mental disorders IV (DSM-IV) criteria for depressive disorders when scores are ≤ 50 [27]. Therefore, this study used the cut-off score of ≤ 50 on the WHO-5 Well-being Index, which was validated for its adequacy, to screen workers with depressive symptoms [27].

2.3. Other covariates

Covariates included socio-demographic characteristics (sex and age), socioeconomic characteristics (education level and average monthly income), and occupational environmental factors (occupational classification, work sector, size of enterprises, working hour, shiftwork, and employment status). These were based on data from the KWCS.

Sex was categorized as male and female. Age was categorized into three quartiles (<30 , $30-49$, and ≥ 50) [28], with age classification used solely in stratification analysis. Education level was categorized into three groups (middle school graduate or lower, high school graduate, and university graduate or higher); and income level was divided into three categories based on participants' monthly average income (<200 , $200-299$, and ≥ 300 million South Korean won, KRW) [29]. Occupational classification comprised white-collar (managers, professionals, related workers, and clerks), pink-collar (service occupation and sales occupation), and blue-collar workers (craft and related occupations; plant and machine operatives; other occupations in agriculture, forestry, and fishing; and other elementary occupations). Work sector was categorized as private and public enterprises according to the organization's characteristics. Company size was classified into three groups: <5 , $5-49$, $50-299$, and ≥ 300 workers [30]. Working hours per week were categorized into ≤ 40 , $41-52$, and >52 hours [31]. Variable-shift work was distinguished as yes or no, based on the presence or absence of shift work. Employment status was classified into two groups—stable and unstable workers—using the questions “Which of the following is the type of employment under your contract?” and “Did you set an employment contract period when you were hired?” Stable workers were defined as participants whose employment period had not been determined until retirement or those with permanent employment contracts. Unstable workers were defined as those with fixed employment periods or with temporary employment contracts [30,32]. Self-rated health was divided into two categories: good (sometimes referred to as “very good,” “good” or “fair”) and poor (“very bad” or “bad”) using the question “How is your health in general?” [33].

2.4. Statistical analysis

Frequency analysis was conducted to elucidate the demographic and occupational profiles of workers affected by downsizing. It encompassed various factors including sex, age, education and income levels, occupational classification, work sector, company size, working hours per week, shift work, employment status, and self-rated health status. Participant characteristics were analyzed using t-test for continuous variables and χ^2 test for categorical variables,

respectively, based on the downsizing and depressive symptoms. The correlation between downsizing and the prevalence of depressive symptoms was evaluated by deriving odds ratios (ORs) and 95% confidence intervals (CIs) using a meticulously adjusted multivariable logistic regression analysis. Model 1 included a crude analysis; Model 2 controlled for socio-demographic characteristics; Model 3 included socio-demographic and socioeconomic characteristics; and Model 4 controlled for the factors in Model 3, occupational environmental factors and self-related health. A subgroup analysis was also performed on the entire population and within each stratum, categorized by employment status, using multivariable logistic regression models. *p*-values were considered statistically significant if they were <0.05 . All statistical analyses used in this study were conducted using the R software (R Foundation for Statistical Computing, Vienna, Austria, version 4.3.3).

3. Results

Of the 26,247 participants, 47.5% (12,460) were men, and 52.5% (13,787) were women. Participants' mean age was 42.6 ± 11.5 years for men and 44.1 ± 11.7 years for women.

Table 1 shows the relationship between the participant characteristics and downsizing experience. Of the 26,247 participants, 3,978 experienced downsizing (15.2%): 2,014 (50.6%) men and 1,964 (49.4%) women. Downsizing had a higher prevalence among

Table 1
Comparison of baseline characteristics among groups with and without downsizing (N = 26,247)

Variables	Total		<i>p</i>
	No downsizing	Downsizing	
Depressive symptoms			
Normal	15,978 (86.4%)	2518 (13.6%)	<0.001
Depressive symptoms	6291 (81.2%)	1460 (18.8%)	
Sex			
Male	10,446 (83.8%)	2014 (16.2%)	<0.001
Female	11,823 (85.8%)	1964 (14.2%)	
Age	43.1 ± 11.7	45.2 ± 10.9	<0.001
Education level			
Middle school or below	1048 (83.4%)	209 (16.6%)	<0.001
High school	7747 (83.7%)	1514 (16.3%)	
University or higher	13,474 (85.7%)	2255 (14.3%)	
Income level			
<200	5922 (87.1%)	874 (12.9%)	<0.001
$200-299$	8104 (85.1%)	1419 (14.9%)	
≥ 300	8243 (83.0%)	1685 (17.0%)	
Occupational classification			
White-collar	10,920 (86.0%)	1777 (14.0%)	<0.001
Pink-collar	5437 (84.6%)	991 (15.4%)	
Blue-collar	5912 (83.0%)	1210 (17.0%)	
Working sector			
Private	18,961 (83.5%)	3741 (16.5%)	<0.001
Public etc.	3308 (93.3%)	237 (6.7%)	
Size of company			
<5	19,352 (85.6%)	3258 (14.4%)	<0.001
$5-49$	1330 (80.7%)	318 (19.3%)	
$50-299$	876 (80.4%)	213 (19.6%)	
≥ 300	711 (79.0%)	189 (21.0%)	
Working hour			
≤ 40	15,878 (85.9%)	2611 (14.1%)	<0.001
$41-52$	4946 (82.8%)	1030 (17.2%)	
>52	1445 (81.1%)	337 (18.9%)	
Shiftwork			
Yes	2102 (84.5%)	385 (15.5%)	0.656
No	20,167 (84.9%)	3593 (15.1%)	
Employment status			
Stable	16,353 (84.4%)	3015 (15.6%)	0.002
Unstable	5916 (86.0%)	963 (14.0%)	
Self-rated health			
Good	16,726 (86.1%)	2699 (13.9%)	<0.001
Poor	5543 (81.3%)	1279 (18.7%)	

participants with the following characteristics: male sex, older age, low education level, high income level, blue-collar workers, private work sector, large-sized companies, long working hours, poor self-rated health, and stable workers (all $p < 0.05$).

Table 2 summarizes the basic characteristics of male and female with depressive symptoms. Depressive symptoms occurred in 30.1% (7,751) of the participants: 3,755 (48.4%) men and 3,996 (51.6%) women. Depressive symptoms had a higher prevalence among participants with the following characteristics: low education level, low income level, blue-collar workers, private work sector, long working hours, shift workers, poor self-rated health, and unstable workers in both male and female participants (all $p < 0.05$).

The ORs and CIs derived from the multivariate logistic regression model were used to ascertain the association between depressive symptoms and downsizing in male and female participants (Table 3). After adjusting for the covariates in Model 4, the adjusted OR (95% CI) for depressive symptoms with downsizing was 1.39 (1.29–1.50). In the stratification analysis according to sex, the fully adjusted OR (95% CI) of depressive symptoms by downsizing was 1.48 (1.33–1.64) in men and 1.31 (1.18–1.46) in women.

Table 4 presents the results of stratification analysis examining the relationship between downsizing and depressive symptoms. The association between depressive symptoms and organizational downsizing was prominently high among workers with higher education (university or higher, OR: 1.51, 95% CI: 1.36–1.66) and higher income levels (≥ 300 , OR: 1.60, 95% CI: 1.42–1.80), white-

collar workers (OR: 1.58, 95% CI: 1.41–1.76), workers in private sectors (OR: 2.04, 95% CI: 1.53–2.71), and stable workers (OR: 1.52, 95% CI: 1.40–1.66), with significant interaction (all p for interaction measured <0.05).

Supplementary Table 1 expands on the findings presented in Table 4, offering further insights into the aspects of employment status not covered in Table 4. Compared with “unstable workers not affected by downsizing,” the OR for depressive symptoms among “unstable workers affected by downsizing” was 1.09 (95% CI: 0.95–1.27). By contrast, in the reference group of “stable workers not affected by downsizing,” the OR for depressive symptoms for “stable workers affected by downsizing” was higher: 1.52 (95% CI: 1.40–1.66). Furthermore, there was a significant increase in the prevalence of depressive symptom among participants with high education and income levels and white-collar employment among stable and unstable workers in the downsizing group.

4. Discussion

This study investigated the relationship between organizational downsizing and depressive symptoms using data derived from a national survey. The association between organizational downsizing and depressive symptoms was confirmed using a multivariable logistic regression model, including adjustments for variables such as sex, age, education level, income, occupational characteristics, employment sector, company size, working hours, shift work, self-rated health, and employment status. Additionally, stratified

Table 2
Comparison of baseline characteristics among groups with and without depressive symptoms stratified by sex ($N = 26,247$)

Variables	Male ($n = 12,460$)			Female ($n = 13,787$)		
	Normal ($n = 8,705$)	Depressive symptoms ($n = 3,755$)	p	Normal ($n = 9,791$)	Depressive symptoms ($n = 3,996$)	p
Downsizing						
No downsizing	15,978 (71.7%)	6291 (28.3%)	<0.001	8514 (72.0%)	3309 (28.0%)	<0.001
Downsizing	2518 (63.3%)	1460 (36.7%)		1277 (65.0%)	687 (35.0%)	
Age	42.9 ± 11.6	44.7 ± 11.6	<0.001	43.6 ± 11.6	45.4 ± 11.7	<0.001
Education level						
Middle school or below	714 (56.8%)	543 (43.2%)	<0.001	470 (59.0%)	327 (41.0%)	<0.001
High school	6189 (66.8%)	3072 (33.2%)		3516 (68.6%)	1609 (31.4%)	
University or higher	11,593 (73.7%)	4136 (26.3%)		5805 (73.8%)	2060 (26.2%)	
Income level						
<200	4497 (66.2%)	2299 (33.8%)	<0.001	3523 (66.8%)	1752 (33.2%)	<0.001
200–299	6670 (70.0%)	2853 (30.0%)		4157 (72.6%)	1565 (27.4%)	
≥ 300	7329 (73.8%)	2599 (26.2%)		2111 (75.7%)	679 (24.3%)	
Occupational classification						
White-collar	9336 (73.5%)	3361 (26.5%)	<0.001	5136 (73.6%)	1843 (26.4%)	<0.001
Pink-collar	4571 (71.1%)	1857 (28.9%)		3226 (70.5%)	1349 (29.5%)	
Blue-collar	4589 (64.4%)	2533 (35.6%)		1429 (64.0%)	804 (36.0%)	
Working sector						
Private	15,881 (70.0%)	6821 (30.0%)	<0.001	8295 (70.6%)	3454 (29.4%)	0.011
Public etc.	2615 (73.8%)	930 (26.2%)		1496 (73.4%)	542 (26.6%)	
Size of company						
<5	15,797 (69.9%)	6813 (30.1%)	<0.001	8728 (70.8%)	3594 (29.2%)	0.551
5–49	1219 (74.0%)	429 (26.0%)		579 (72.6%)	218 (27.4%)	
50–299	799 (73.4%)	290 (26.6%)		322 (73.0%)	119 (27.0%)	
≥ 300	681 (75.7%)	219 (24.3%)		162 (71.4%)	65 (28.6%)	
Working hour						
≤ 40	13,279 (71.8%)	5210 (28.2%)	<0.001	7336 (71.7%)	2902 (28.3%)	<0.001
41–52	4106 (68.7%)	1870 (31.3%)		1990 (70.5%)	833 (29.5%)	
> 52	1111 (62.3%)	671 (37.7%)		465 (64.0%)	261 (36.0%)	
Shiftwork						
Yes	1691 (68.0%)	796 (32.0%)	0.005	803 (68.1%)	377 (31.9%)	0.021
No	16,805 (70.7%)	6955 (29.3%)		8988 (71.3%)	3619 (28.7%)	
Employment status						
Stable	14,100 (72.8%)	5268 (27.2%)	<0.001	7138 (73.7%)	2553 (26.3%)	<0.001
Unstable	4396 (63.9%)	2483 (36.1%)		2653 (64.8%)	1443 (35.2%)	
Self-rated health						
Good	14,790 (76.1%)	4635 (23.9%)	<0.001	7693 (76.6%)	2350 (23.4%)	<0.001
Poor	3706 (54.3%)	3116 (45.7%)		2098 (56.0%)	1646 (44.0%)	

Table 3
Multivariate logistic regression for depressive symptoms associated with downsizing

		Model 1	Model 2	Model 3	Model 4
Total					
	No downsizing	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
	Downsizing	1.47 (1.37–1.58)	1.44 (1.34–1.55)	1.45 (1.35–1.56)	1.39 (1.29–1.50)
Male					
	No downsizing	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
	Downsizing	1.56 (1.41–1.72)	1.53 (1.38–1.69)	1.55 (1.40–1.71)	1.48 (1.33–1.64)
Female					
	No downsizing	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
	Downsizing	1.38 (1.25–1.53)	1.36 (1.22–1.50)	1.37 (1.24–1.52)	1.31 (1.18–1.46)

Model 1: crude model.

Model 2: adjusted by sex and age.

Model 3: adjusted by sex, age, education level, and income level.

Model 4: adjusted by sex, age, education level, income level, occupational classification, working sector, size of company, working hour, shiftwork, employment status, and self-rated health.

analysis demonstrated substantial associations between depressive symptoms and downsizing, particularly among stable workers.

Previous studies have explained the impact of organizational downsizing on workers' physical and social health [21,23]. They have emphasized that downsizing exerts a detrimental influence on the psychological work environment, significantly affecting job satisfaction [34], job security [35], and workplace environment, including work demands, interpersonal relationships [20], all of which influence depressive symptoms [36]. A study

conducted in Sweden [21] found that downsizing, which led to layoffs, caused a significant risk of major depression among workers. Brenner et al. [23] found that socially irresponsible downsizing processes correlated with an increase in depressive symptoms among European workers. Similarly, our study substantiates the correlation between downsizing and depressive symptoms among workers.

Investigating the prevalence of depressive symptoms among stable and unstable workers in the context of downsizing is

Table 4
Adjusted odds ratios and 95% confidence intervals for depressive symptoms associated with downsizing

	No downsizing		Downsizing		Adjusted odds ratios and 95% confidence	p for interaction
	Total	Prevalence of depression	Total	Prevalence of depression		
Sex						
Male	10,446	28.55	2014	38.38	1.48 (1.33–1.64)	0.086
Female	11,823	27.99	1964	34.98	1.31 (1.18–1.46)	
Age						
<30	3438	24.17	391	29.16	1.28 (1.00–1.62)	0.243
30–49	11,367	26.85	2054	36.03	1.45 (1.31–1.61)	
≥50	7464	32.26	1533	39.53	1.35 (1.20–1.52)	
Education level						
Middle school or below	1048	42.84	209	44.98	1.01 (0.73–1.38)	0.004
High school	7747	32.03	1514	39.04	1.30 (1.16–1.47)	
University or higher	13,474	24.94	2255	34.37	1.51 (1.36–1.66)	
Income level						
<200	5922	33.18	874	38.22	1.09 (0.93–1.27)	<0.001
200–299	8104	28.58	1419	37.84	1.42 (1.26–1.61)	
≥300	8243	24.38	1685	34.96	1.60 (1.42–1.80)	
Occupational classification						
White-collar	10,920	24.96	1777	35.73	1.58 (1.41–1.76)	0.017
Pink-collar	5437	28.27	991	32.29	1.20 (1.03–1.39)	
Blue-collar	5912	34.3	1210	41.74	1.32 (1.16–1.51)	
Working sector						
Private	18,961	28.79	3741	36.41	1.36 (1.26–1.47)	0.008
Public etc.	3308	25.15	237	41.35	2.04 (1.53–2.71)	
Size of company						
<5	19,352	28.9	3258	37.45	1.38 (1.27–1.50)	0.838
5–49	1330	23.83	318	35.22	1.56 (1.18–2.07)	
50–299	876	24.43	213	35.68	1.51 (1.06–2.16)	
≥300	711	23.49	189	27.51	1.17 (0.77–1.77)	
Working hour						
<40	15,878	27.03	2611	35.16	1.40 (1.27–1.53)	0.776
41–52	4946	29.88	1030	38.06	1.42 (1.22–1.64)	
>52	1445	36.06	337	44.51	1.35 (1.05–1.74)	
Shiftwork						
Yes	2102	30.69	385	39.22	1.36 (1.08–1.73)	0.802
No	20,167	28	3593	36.43	1.39 (1.29–1.51)	
Employment status						
Stable	16,353	25.65	3015	35.62	1.52 (1.40–1.66)	<0.001
Unstable	5916	35.45	963	40.08	1.09 (0.95–1.27)	
Self-rated health						
Good	16,726	23.08	2699	28.71	1.34 (1.22–1.47)	0.332
Poor	5543	43.86	1279	53.56	1.48 (1.30–1.67)	

essential. Typically, unstable workers exhibit poorer health, including higher depressive symptoms, than stable workers [37,38]. However, our analysis indicated that downsizing had a more substantial impact on depressive symptoms among stable workers (OR: 1.52, 95% CI: 1.40–1.66) than among unstable workers (OR: 1.09, 95% CI: 0.95–1.27). This result implies that downsizing is a particularly significant risk factor for depressive symptoms in stable workers, aligning with previous study [39] and indicating higher sickness absence rates among stable workers in downsizing scenarios.

This study indicates prominent association between organizational downsizing and depressive symptoms among high socioeconomic subgroups, including higher education levels, higher income, white-collar workers, and public sector employment, with significant interaction. Despite relatively lower depressive symptoms among high socioeconomic groups in previous studies [40,41], socioeconomically advantaged workers may demonstrate more increased vulnerability to depressive symptoms when confronted with unstable external factors such as downsizing, compared with their counterparts. This observation is consistent with findings from studies conducted during the COVID-19 pandemic, which reported an increased prevalence of depression and anxiety among individuals with higher education and income [42,43]. These implications extend to white-collar workers, who generally possess higher education and income levels than other occupations [44], and to public sector workers, who typically hold higher job security than do private sector workers [45].

Several theories can explain why stable workers, those with higher socioeconomic status, are more affected by the downsizing environment. According to Hobfoll's conservation of resources theory, individuals strive to acquire, retain, and protect their resources, and any reduction is perceived as a significant threat, leading to stress [46]. Such stress reactions, potentially culminating in depression [47], are significantly pronounced among high-income individuals and workers in the public sector when faced with threats to their financial stability and job security. Habituation theory posits that repeated exposure to stressors decreases the response over time [48]. Unstable workers, who are constantly exposed to job insecurity stress, may become habituated to these stresses and thus less sensitive to the additional stress of downsizing. The theory of relative deprivation provides further insights into the association between depressive symptoms and higher educational attainment in the context of downsizing. Relative deprivation is a feeling of anger and resentment from perceived inferiority to a reference standard [49], which is associated with adverse health outcomes [50]. Therefore, workers with higher education levels may experience acute emotional distress due to the gap between their expectations and reality following downsizing.

The socioeconomic crisis significantly impacts the prevalence of downsizing [15]. Global crises such as the COVID-19 pandemic have led to an increase in companies implementing downsizing or massive layoffs [51]. Compared to our study, pre-COVID cross-sectional studies in four European countries show a slightly higher extent of association between depressive symptoms and organizational downsizing [52]. This difference might be attributable to the general increase in depression observed during the pandemic [4], leading to a potential rise in depressive symptoms among the reference group (survivors) and consequently diminishing the strength of the observed association. Sociocultural differences may also account for these variations. As previous studies indicate, the impact of downsizing is influenced by social and cultural organizational factors [53]. Research conducted in Europe shows that the correlation between downsizing and adverse employee health outcomes was more pronounced in Hungary, likely due to the lack of unemployment social security systems [54]. Therefore, in contexts where downsizing is unavoidable, it is imperative for

governments to establish comprehensive unemployment social security measures and implement policies tailored to the distinct socioeconomic occupational characteristics, including employment status.

This study has several strengths. First, the data analyzed in this study were obtained from the KWCS, a reliable and representative national survey that provides comprehensive insights into the working environment and workers' health issues. Second, to the best of our knowledge, this study is the most recent investigation of the relationship between downsizing and depression among Korean workers during the COVID-19 pandemic. Finally, this study uses stratification analysis to explore the effects of downsizing on vulnerable populations.

This study has several limitations. First, the cross-sectional method precluded examination of the causal relationship between downsizing and depressive symptoms. The study could not identify workers who might have had depression before data collection, and they might have been more sensitive to downsizing. Future studies should use a longitudinal approach to demonstrate the causal relationship between downsizing and depressive symptoms. Second, the data may be biased due to self-reporting as workers might not accurately perceive or report downsizing. Additionally, the lack of information on the causes of decreased employee numbers and the temporal difference between downsizing (past three years) and depressive symptoms (last two weeks) may obscure the relationship. Future research should aim to gather more detailed and comprehensive data on downsizing. Finally, since the 6th KWCS used in this study was conducted during the COVID-19 pandemic, the results should be cautiously interpreted. Given the potential changes in various socioeconomic factors due to COVID-19, further research is needed to confirm the correlation between downsizing and depression in workers in the post-COVID-19 period.

Therefore, this study revealed that downsizing is significantly correlated with an increased prevalence of depressive symptoms among workers, particularly those with stable employment and higher education and income levels. Consequently, employers must carefully evaluate the decision to downsize and consider its substantial effects on employees' mental health. Additional longitudinal studies are required to elucidate the risks to workers' mental health associated with downsizing.

Data statement

Data are available in a publicly accessible repository that does not issue DOIs. These data can be found here: <https://oshri.kosha.or.kr/oshri/researchField/downWorkingEnvironmentSurvey.do>.

Ethical statement

The 6th KWCS was conducted by the Republic of Korea Occupational Safety and Health Agency. All participants in the KWCS were asked to provide written consent, and all personally identifiable information was removed. This study followed the ethical guidelines of the 2013 Declaration of Helsinki and was approved by the Institutional Review Board of Severance Hospital (IRB: 4-2021-1046). As this was a retrospective study, informed consent was not required from the participants.

CRediT authorship contribution statement

Youngsun Park: Writing—review and editing, Writing—original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Juyeon Oh:** Visualization, Validation, Resources, Methodology. **Heejoo Park:** Software, Resources, Investigation, Formal analysis. **Jian Lee:** Visualization, Software, Formal analysis,

Data curation. **Byungyoon Yun:** Writing—review and editing, Writing—original draft, Validation, Supervision, Project administration, Data curation, Conceptualization. **Jin-Ha Yoon:** Validation, Supervision, Project administration, Funding acquisition.

Conflicts of interest

The authors declare no conflict of interest.

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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.2024.06.005>.

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