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Association of discrimination and presenteeism with cardiovascular disease: the Fourth Korean Working Conditions Survey

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Abbreviations
CI: confidence interval; KWCS: Korea Working
Conditions Survey; KRW: Korean won; OR:
odds ratio.

Competing interests
The authors declare that they have no
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ABSTRACT

Background: Discrimination is a representative social determinant of health. Presenteeism is defined as presenting to work despite of illness and is an indicator of group health. We investigated the association of discrimination and presenteeism with cardiovascular disease using Korean data.

Methods: This study used the fourth Korea Working Conditions Survey (2014) data of 27,662 wage workers (employees). Presenteeism and discrimination related to age, sex, education, birth region, and employment type were ascertained. Self-reported cardiovascular disease was also assessed using the survey questionnaire. General and occupational characteristics found to be significant in univariate analyses were entered into a multivariate logistic regression analysis of the association of discrimination and presenteeism with cardiovascular disease. We also calculated the odds ratios of multiple discriminations and/or presenteeism for cardiovascular disease.

Results: In the univariate analyses, sex, age, education, monthly income, employment type, occupation, hours worked per week, workplace scale, and shift work were significantly associated with cardiovascular disease. A multivariate logistic regression analysis adjusted for general and occupational characteristics showed that discrimination and presenteeism were significantly associated with cardiovascular disease. Finally, the association with cardiovascular disease was strongest when both multiple discriminations and presenteeism were present.

Conclusions: Discrimination and presenteeism are associated with cardiovascular disease, and this association was stronger in the presence of multiple types of discrimination and presenteeism.

Keywords: Discrimination; Presenteeism; Cardiovascular disease; Korea Working Conditions Survey

BACKGROUND

Discrimination is a representative social determinant of health [1]. Discrimination, which is defined as treating certain individuals or groups more poorly than others, is a type of control

that socially isolates a fundamentally equal object by unequal treatment based on arbitrary criteria [2]. Discrimination involves unfair treatment based on sex, age, race, affiliation, and/or status [1,3], disregards people as individuals, renders their strengths irrelevant, disadvantages them by identifying them with their group affiliation, and even assumes that they are morally inferior on the basis of such group affiliation [4]; it is also associated with stereotyping [5]. Discrimination in the labor market can be based on sex, age, education, birth region, or appearance [1]; it not only negatively affects work life but also is a major cause of social problems.

Presenteeism refers to a situation in which a worker comes to work despite the fact that he or she is unable to work due to illness. Presenteeism is contrasted with absenteeism, which is repeated inappropriate absences from work; both presenteeism and absenteeism reduce productivity [6]. Presenteeism can have serious adverse effects on health as well as productivity and is a representative indicator of the health level of a group [7]. Health risks and stress are reportedly associated with presenteeism [8-10], and presenteeism is also a social determinant of health.

Previous studies that have researched the association between social factors and health effects have focused on the psychological factors that individuals feel rather than the workplace culture. In other words, previous studies used the experience of discrimination measured by the questionnaire as the main variable, while the presenteeism reflecting the workplace culture itself was mainly used as a result variable to replace absenteeism. The association between discrimination and presenteeism has been reported in previous papers [9], but some of them do not show it clearly [8]. Actual discrimination and presenteeism can be thought of as parallel factors that share one upper domain of work culture as well as aspects that are related to each other and at the same time interact with health. In other words, it can be assumed that discrimination and presenteeism are indicators of a typical workplace culture and interact with workers' health. Therefore, it is worth to analyze whether the multiple discrimination and presenteeism interact with cardiovascular disease, a health effect that has been rarely studied in Korean studies until now.

Cardiovascular disease includes congenital heart disease, ischemic heart disease, arrhythmia, cardiomyopathy, and stroke and can be classified into heart disease, cerebrovascular disease, and hypertensive disease [11,12]. The most common risk factors for cardiovascular disease are hypertension, diabetes, hyperlipidemia, smoking, alcohol overload, and obesity [11]. According to Statistics Korea [12], cardiovascular disease is the second leading cause of death after malignant neoplasia, and the mortality rate increases with age. The incidence of cardiovascular disease increases in the order of heart disease, cerebrovascular disease, and hypertensive disease. The mortality rate of ischemic heart disease is higher in persons in their 40s to 70s, whereas the mortality rate of other heart diseases is higher in persons below their 40s.

Social epidemiology studies the social distribution of determinants of health and the relationship between social determinants of health and disease as the socioeconomic conditions of an individual may cause disease [13,14]. Social determinants of health include not only birth, age, sex, and education but also socioeconomic indicators, such as income/wealth, occupation, disability, and discrimination [1,13]. The volume of research on the relationship between discrimination and health effects is increasing [1,3,15-22]. However, the experience of discrimination in Korea has not been investigated extensively, and most

extant works focus on mental disorders (e.g., depression, insomnia, and suicidal ideation) [23-26]. Although some studies have addressed physical symptoms and illnesses, these were categorized according to symptoms, self-rated overall health, or occupational injuries [19,21,27]. In the West, most studies of cardiovascular disease and discrimination have focused on racism [15-18]. Also, studies of the relationship between cardiovascular disease and discrimination based on education or birth region, which are important issues in Korean society, are rare. Additionally, most previous studies have considered presenteeism as a health outcome that substitutes for the absence rate index or as a factor that decreases productivity [810]. However, presenteeism may also reflect the social character of a worker's organization or group.

Here, we investigated the association of discrimination and presenteeism, which are social determinants of health and problems in the workplace, with cardiovascular disease.

METHODS

Study subjects

This study used data from the fourth Korea Working Conditions Survey (KWCS) conducted from June 1 to August 31, 2014 by the Korea Occupational Safety and Health Agency [28]. The 2014 KWCS was developed from the questionnaire of the European Working Conditions Survey, which was administered in Europe in 2010. This survey collected data on socioeconomic characteristics, job performance, work environment, exposure to risk factors, and health-related issues. According to the final report of the KWCS [7], the survey was completed by workers aged ≥ 15 years, and the survey area covered 17 cities and provinces nationwide. A stratified cluster sampling method was used, and one-on-one individual interviews were conducted through a household visit by a professional investigator. As a result, data from 50,007 survey respondents were collected.

Of the 50,007 survey respondents, the data from 27,662 wage workers (employees) were used after excluding individuals with missing values (e.g., unknown, no response, rejection, and others). A weighted statistical analysis was performed to increase the representativeness of the survey group.

Variables

General characteristics
Data on subjects' general characteristics were collected using questionnaires. Sex was classified as male or female, and age was categorized as 15–24, 25–34, 35–44, 45–54, or ≥ 55 years. Educational level was classified as middle school graduate or lower, high school graduate, or college graduate or higher. Monthly income was categorized as ≤ 999,000 Korean won (KRW), 1,000,000–1,990,000 KRW, 2,000,000–2,990,000 KRW, or ≥ 3,000,000 KRW.

Occupational characteristics
We assessed the following: employment type, occupation, hours worked per week, workplace scale, and shift work. Employment type was classified as regular workers or non-regular workers (temporary or part-time). Occupation was classified as white collar (managers, experts, technicians, semi-professionals, and clerical workers), service and sales (service and sales workers), or blue collar (skilled workers in agriculture, forestry, and fishery, functional workers and related function workers, machine operators and assembly-line workers,

simple laborers, and soldiers). Based on the legal classification, hours worked per week was categorized as ≤ 40, 41–52, 53–60, or ≥ 61 hours. Workplaces were classified as those with ≤ 49, 50–299, or ≥ 300 workers. Shift work was identified as a "Yes" response to the question "Do you work shifts?"

Discrimination
Individuals who responded "Yes" to the question "Have you experienced the following discrimination in relation to work in the last 12 months?" were considered to have experienced discrimination. Discrimination was analyzed by age, sex, education, birth region, and employment type.

Presenteeism
Individuals who responded "Yes" to the question "Have you ever come to work in the last 12 months despite being ill?" were considered to have experienced presenteeism.

Cardiovascular disease
Individuals who responded "Yes" to the "Cardiovascular disease" in the question "Did you have any of the following health problems in the last 12 months?" were considered to have cardiovascular disease.

Statistical analysis
To investigate the associations of general and occupational characteristics with cardiovascular disease, chi-square tests were used to perform univariate analyses. Specifically, associations of discrimination and presenteeism with cardiovascular disease were evaluated by χ^2 tests. A multivariate logistic regression analysis was performed to evaluate associations among discrimination, presenteeism, and cardiovascular disease after adjusting for the general and occupational characteristics that demonstrated statistical significance in univariate analyses. To calculate odds ratios (ORs) according to the presence or absence of presenteeism and two or more types of discrimination, a multivariate logistic regression analysis adjusted for general and occupational characteristics was performed. Statistical significance was set at $p < 0.05$, and SPSS v. 25.0 (IBM Corp., Armonk, NY, USA) was used for all analyses.

RESULTS

Subjects' general and occupational characteristics
Of the subjects, 50.5% and 49.5% were males and females, respectively. The mean age was 43.6 years, and those aged 35–44 years accounted for a plurality of the sample (27.7%). In terms of education, 51.1% of workers had, at least, graduated from college; 37.0% had graduated from high school; and 11.9% had, at most, graduated from middle school. The most common monthly income bracket was 1,000,000–1,990,000 KRW. The proportion of regular workers was 75.1%, whereas that of non-regular workers was 24.9%. A plurality (43.6%) of subjects were white-collar workers. Moreover, 53.0% worked ≤ 40 hours per week, and 73.2% worked in small workplaces (≤ 49 workers). The proportion of shift workers (10.0%) was considerably lower than that of non-shift workers (90.0%).

Associations of general and occupational characteristics with cardiovascular disease

Of the respondents, 1.4% reported having cardiovascular disease. Sex, age, education, monthly income, employment type, occupation, hours worked per week, workplace scale, and shift work were significantly associated with cardiovascular disease (**Table 1**). The rate of cardiovascular disease was higher in males (1.7%) than in females (1.1%). Also, the rate of cardiovascular disease increased with age and with decreasing educational level. In terms of monthly income, the rate of cardiovascular disease was highest in the ≤ 990,000 KRW group, and lowest in the 2,000,000–2,990,000 KRW group. The rate of cardiovascular disease in non-regular workers was 2.2%, compared to 1.1% in regular workers. In terms of occupation, blue-collar workers had the highest rate of cardiovascular disease (2.5%). The rate of cardiovascular disease was highest in those working ≥ 61 working hours per week and those in businesses with ≤ 49 workers; shift workers had a higher rate of cardiovascular disease than non-shift workers.

Table 1. General and occupational characteristics of study subjects by cardiovascular disease

Characteristics	No. (%)	Cardiovascular disease		p-value
		No	Yes	
Sex				< 0.001
Male	13,973 (50.5)	13,742 (98.3)	231 (1.7)	
Female	13,689 (49.5)	13,543 (98.9)	146 (1.1)	
Age				< 0.001
15–24	1,542 (5.6)	1,538 (99.7)	4 (0.3)	
25–34	5,942 (21.5)	5,929 (99.8)	13 (0.2)	
35–44	7,661 (27.7)	7,605 (99.3)	56 (0.7)	
45–54	7,032 (25.4)	6,931 (98.6)	101 (1.4)	
≥ 55	5,486 (19.8)	5,282 (96.3)	204 (3.7)	
Education				< 0.001
Middle school graduate or lower	3,279 (11.9)	3,124 (95.3)	155 (4.7)	
High school graduate	10,245 (37.0)	10,126 (98.8)	119 (1.2)	
College graduate or higher	14,139 (51.1)	14,036 (99.3)	103 (0.7)	
Monthly income (KRW)				< 0.001
≤ 990,000	3,475 (12.6)	3,357 (96.6)	118 (3.4)	
1,000,000–1,990,000	9,639 (34.8)	9,517 (98.7)	122 (1.3)	
2,000,000–2,990,000	7,884 (28.5)	7,835 (99.4)	49 (0.6)	
≥ 3,000,000	6,665 (24.1)	6,576 (98.7)	89 (1.3)	
Employment type				< 0.001
Regular	20,787 (75.1)	20,558 (98.9)	229 (1.1)	
Temporary or part-time	6,875 (24.9)	6,727 (97.8)	148 (2.2)	
Occupation				< 0.001
White collar	12,066 (43.6)	11,965 (99.2)	101 (0.8)	
Service, sales	6,944 (25.1)	6,887 (99.2)	57 (0.8)	
Blue collar	8,654 (31.3)	8,434 (97.5)	220 (2.5)	
Hours worked per week				0.023
≤ 40	14,664 (53.0)	14,449 (98.5)	215 (1.5)	
41–52	8,018 (29.0)	7,931 (98.9)	87 (1.1)	
53–60	3,487 (12.6)	3,441 (98.7)	46 (1.3)	
≥ 61	1,493 (5.4)	1,464 (98.1)	29 (1.9)	
Workplace scale (person)				0.004
≤ 49	20,247 (73.2)	19,943 (98.5)	304 (1.5)	
50–299	5,249 (19.0)	5,199 (99.0)	50 (1.0)	
≥ 300	2,165 (7.8)	2,142 (98.9)	23 (1.1)	
Shift work				0.008
No	24,897 (90.0)	24,573 (98.7)	324 (1.3)	
Yes	2,765 (10.0)	2,712 (98.1)	53 (1.9)	
Total	27,662 (100.0)	27,285 (98.6)	377 (1.4)	

Values are presented as number (%). Calculated by Pearson's χ^2 test.
KRW: Korean won.

Distribution of discrimination and presenteeism by cardiovascular disease

The rate of respondents who reported presenteeism and each type of discrimination differed not only by general and occupational characteristics but also by type of discrimination. Specifically, 6.1% experienced discrimination related to age, 1.9% experienced discrimination related to sex, 5.3% experienced discrimination related to education, 1.8% experienced discrimination related to birth region, and 3.7% experienced discrimination related to employment type. Moreover, 22.8% reported experiences of presenteeism. The rate of cardiovascular disease according to discrimination type was as follows: 3.6% by age, 2.1% by sex, 3.4% by education, 3.7% by birth region, and 3.2% by employment type. Of those who experienced presenteeism, 2.1% had cardiovascular disease. Additionally, more experiences of discrimination were positively related to higher rates of cardiovascular disease. According to the univariate analysis, discrimination related to age, education, birth region, employment type, and presenteeism were significantly associated with cardiovascular disease, but discrimination related to sex was not statistically significant in association with cardiovascular disease (**Table 2**).

Associations of discrimination and presenteeism with cardiovascular disease

A multivariate logistic regression analysis adjusted for sex, age, education, monthly income, employment type, occupation, hours worked per week, workplace scale, and shift work showed that discrimination and presenteeism were significantly associated with cardiovascular disease (**Table 3**). Additionally, the OR for cardiovascular disease was higher in individuals who experienced multiple types of discrimination.

Table 2. Distribution of discrimination and presenteeism by cardiovascular disease

Characteristics	No. (%)	Cardiovascular disease		p-value
		No	Yes	
Discrimination by age				< 0.001
No	25,975 (93.9)	25,659 (98.8)	316 (1.2)	
Yes	1,687 (6.1)	1,626 (96.4)	61 (3.6)	
Discrimination by sex				0.157
No	27,130 (98.1)	26,764 (98.7)	366 (1.3)	
Yes	532 (1.9)	521 (97.9)	11 (2.1)	
Discrimination by education				< 0.001
No	26,192 (94.7)	25,865 (98.8)	327 (1.2)	
Yes	1,471 (5.3)	1,420 (96.5)	51 (3.5)	
Discrimination by birth region				< 0.001
No	27,158 (98.2)	26,800 (98.7)	358 (1.3)	
Yes	504 (1.8)	485 (96.2)	19 (3.8)	
Discrimination by employment type				< 0.001
No	26,637 (96.3)	26,293 (98.7)	344 (1.3)	
Yes	1,025 (3.7)	992 (96.8)	33 (3.2)	
No. of types of discrimination				< 0.001
0	24,216 (87.5)	23,927 (98.8)	289 (1.2)	
1	2,178 (7.9)	2,142 (98.3)	36 (1.7)	
2	890 (3.2)	862 (96.9)	28 (3.1)	
3 or more	378 (1.4)	354 (93.7)	24 (6.3)	
Presenteeism				< 0.001
No	21,356 (77.2)	21,110 (98.8)	246 (1.2)	
Yes	6,306 (22.8)	6,175 (97.9)	131 (2.1)	
Total	27,662 (100.0)	27,285 (98.6)	377 (1.4)	

Values are presented as number (%). Calculated by Pearson's χ^2 test.

Table 3. ORs of discrimination and presenteeism for cardiovascular disease

Characteristics	Crude		Adjusted[a]	
	OR	95% CI	OR	95% CI
Discrimination by age				
No	1.00		1.00	
Yes	3.05	2.31–4.03	2.41	1.81–3.22
Discrimination by sex				
No	1.00		1.00	
Yes	1.54	0.84–2.83	2.53	1.38–4.66
Discrimination by education				
No	1.00		1.00	
Yes	2.84	2.11–3.83	3.88	2.84–5.31
Discrimination by birth region				
No	1.00		1.00	
Yes	2.93	1.83–4.69	4.22	2.60–6.85
Discrimination by employment type				
No	1.00		1.00	
Yes	2.54	1.77–3.65	2.42	1.67–3.52
No. of types of discrimination				
1 or none	1.00		1.00	
Multiple (2 or more)	3.43	2.55–4.62	3.85	2.83–5.24
Presenteeism				
No	1.00		1.00	
Yes	1.82	1.47–2.26	1.93	1.55–2.40

OR: odds ratio; CI: confidence interval.
[a]Multivariate logistic regression analysis adjusted for sex, age, education, monthly income, employment type, occupation, hours worked per week, workplace scale, and shift work.

Table 4. ORs of multiple types of discrimination with presenteeism for cardiovascular disease

No. of types of discrimination	Presenteeism			
	No		Yes	
	Adjust OR[a]	95% CI	Adjust OR[a]	95% CI
One or none	1.00	-	1.58	1.24–2.01
	(n = 20,516, 74.2%)		(n = 5,878, 21.3%)	
Multiple (2 or more)	2.25	1.38–3.68	8.64	5.82–12.84
	(n = 841, 3.0%)		(n = 427, 1.5%)	

OR: odds ratio; CI: confidence interval.
[a]Multivariate logistic regression analysis adjusted for sex, age, education, monthly income, employment type, occupation, hours worked per week, workplace scale, and shift work.

ORs of multiple types of discrimination with presenteeism for cardiovascular disease

Subjects were divided into the following 4 groups: 1) non-multiple discrimination without presenteeism (74.2%, 20,516 individuals), 2) non-multiple discrimination with presenteeism (21.3%, 5,878 individuals), 3) multiple discrimination without presenteeism (3.0%, 841 individuals), and 4) multiple discrimination with presenteeism (1.5%, 427 individuals). A multivariate logistic regression analysis adjusted for general and occupational characteristics (sex, age, education, monthly income, employment type, occupation, hours worked per week, workplace scale, and shift work) showed that the adjusted OR for reporting multiple types of discrimination and presenteeism compared to reporting one type or no type of discrimination without presenteeism was 8.64 (95% confidence interval: 5.82–12.84) (**Table 4**).

DISCUSSION

We report here a significant association of discrimination and presenteeism with cardiovascular disease. The OR for cardiovascular disease was significantly higher in individuals who

experienced discrimination than in those with no experience of discrimination, and experiences with both presenteeism and discrimination increased the ORs for cardiovascular disease. Additionally, groups that experienced multiple types of discrimination had higher ORs for cardiovascular disease than those who had experienced one or no types of discrimination, and the ORs for cardiovascular disease were higher when discrimination and presenteeism were combined. The increase in the ORs for presenteeism was greater in the presence of multiple types of discrimination than in the presence of one or none.

One particular result to note is that when stratified by sex (**Supplementary Tables 1-6**), the cardiovascular effects of all the discriminations and presenteeism were significant for males, but, most discriminations, except for by age, were not significant for females. The difference in the cardiovascular effects of discriminations, we think, can be due to the emotional vulnerability of males in male-dominating society, when faced with the stress of discrimination. In the male-dominating society, like in Korea, boys are raised to be strong against stress with little expectation of social support or buffering networks. Another result to note is the stronger effects of discrimination and presenteeism for the younger subjects when stratified by age (**Supplementary Tables 7-12**) For the age group 55 years or younger, the prevalence of cardiovascular disease was lower, but the effect of discrimination or presenteeism itself was much greater than those 55 years or older, which seems to indicate much greater pressure of work on the younger and economically more active subjects. The prevalence of cardiovascular disease was higher in males and older persons. Additionally, the prevalence of cardiovascular disease was higher in less educated workers, non-regular workers, blue-collar workers, and shift workers. In terms of monthly income, hours worked hours per week, and workplace scale, the highest rates of cardiovascular disease were in the those earning ≤ 999,000 KRW, those working ≥ 61 hours, and those employed by businesses with ≤ 49 workers, respectively. The rate of cardiovascular disease was slightly higher in groups with the highest monthly income (≥ 3,000,000 KRW), shortest working hours (≤ 40 hours), and largest workplaces (≥ 300 workers), showing a U-shaped distribution.

Racism is associated with cardiovascular disease [17]. Discrimination based on age, education, birth region, and employment type was significantly associated with cardiovascular disease. Non-discrimination at work reportedly reduces the rate of cardiovascular disease [29], and different types of discrimination are associated with other health effects [1]. In this study, social determinants, such as discrimination, had a significant negative effect on health.

The effect of adjustment on the ORs for the relationship between discrimination and cardiovascular disease differed according to the type of discrimination. The ORs for discrimination by age and employment type decreased after correcting for other variables. However, the ORs for discrimination by education and birth region increased after correcting for other variables. This means that the distribution of each type of discrimination varies according to general and occupational characteristics [22]. This suggests that the social determinants of health, such as discrimination or presenteeism, should be managed differently according to sex, age, and employment type. Although not included in this paper, discrimination based on religion, disability, and race was not associated with cardiovascular disease, possibly because of the low incidence of such discrimination in the data. Indeed, in this study, the rates of discrimination based on the following characteristics were less than 1%: religion (0.3%, 79 individuals), disability (0.5%, 152 individuals), and race (1.0%, 265 individuals). However, racism is associated with cardiovascular disease in Western

studies of African Americans [17]. Discrimination by education or birth region is becoming an important issue in Korean society [1]. Moreover, as the OR for cardiovascular disease increased after correction for discrimination by birth region or educational level, further research is warranted.

The distribution of presenteeism, similar to that of discrimination, differs according to general and occupational characteristics [8,9]. Presenteeism was associated with cardiovascular disease, and it significantly increased the odds of cardiovascular disease among those who had experienced multiple types of discrimination. Future research should analyze presenteeism, as well as discrimination, as a social determinant of health.

The mechanism, by which the discrimination experience affects physical illnesses, such as cardiovascular disease, is unclear. For example, discrimination experiences may cause stress, or discrimination itself could be a type of stress [1,15,18,30]. Indeed, stress affects health by creating emotional distress, which adversely affects health or induces unhealthy habits, such as smoking or excessive drinking, or alters "physiological systems, including the neuroendocrine, autonomic, and immune systems" [15,31]. According to the previous study that described more specific biological plausibility, psychosocial stress "appears to contribute to all recognized mechanisms underlying cardiac events, specifically, clustering of traditional cardiovascular risk factors, endothelial dysfunction, myocardial ischemia, plaque rupture, thrombosis, and malignant arrhythmias" [32]. Additionally, stress is not only involved in the onset but has a negative effect on the progression of chronic diseases, such as cardiovascular disease and cancer [15]. In this study, the questionnaires regarding discrimination, presenteeism, and cardiovascular disease focused on the previous 12 months. However, some cardiovascular diseases are chronic, and whether the disease first developed within the past 12 months cannot be determined. The effects of discrimination on cardiovascular disease may affect the progression of the disease rather than its onset. Discrimination, or presenteeism, can prevent alleviation of the disease or even worsen it, even if it precedes the onset of discrimination. Presenteeism is also associated with stress. According to the KWCS data, discrimination and presenteeism are also related [9]; however, in some retirement surveys, the relevance was unclear [8]. Confirmation of the relationships among discrimination, presenteeism, and stress on health requires further detailed and systematic research. Additionally, not only stress but also other diseases that are affected by discrimination—such as depression, anxiety, and sleep disorders—are mediators of cardiovascular disease. In Western studies, emotions caused by discrimination (e.g., fear, anger, and denial) may have direct effects on the cardiovascular, endocrine, neurologic, and immune systems, and discrimination due to population-level poverty, poor housing quality, political disempowerment, and so on can exert adverse effects on health [3].

Second, discrimination reflects the culture and characteristics of the organization in which workers are housed, and this may detract from the accessibility of medical services or the ease with which workers can engage in healthy behaviors. In this study, discrimination with presenteeism was significantly associated with cardiovascular disease. Multiple types of discrimination and presenteeism may both be the result of reflecting the characteristics of an organization or groups (**Fig. 1**). Considering that the association between discrimination and presenteeism has been reported in previous studies [9], and that the association between discrimination and cardiovascular disease varies depending on whether presenteeism exists or not (**Table 4**), it can be said that discrimination and presenteeism are associated with cardiovascular disease while interacting with each other. It is possible that presenteeism is a
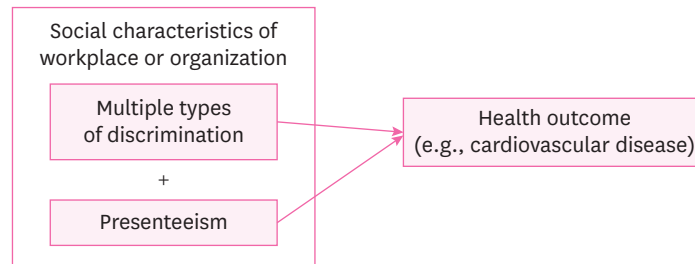
Fig. 1. Synergistic effects of multiple types of discrimination and presenteeism on cardiovascular disease.

better reflection of the characteristics of an organization than is discrimination because the measurement of discrimination is based on the perception of the individual. Presenteeism has been treated as a health outcome or a business-related variable rather than a health-related factor [6-10]. However, future studies should consider presenteeism as a concept that includes the treatment accorded to workers in the workplace. It can also be considered an indicator of organizational justice, reflecting the unfairness of the work environment and the work organization. Organizational justice refers to the degree to which workers feel they are treated fairly in an organization [33]. Previous studies have found that justice at work or organizational justice reportedly affects absences related to sickness, self-rated health, and cardiovascular disease [29]. In addition to individual-level discrimination, studies should focus on objective indicators of the characteristics of the group itself, such as presenteeism or organizational justice, as contributors to the health effect.

This study has the following limitations. First, because this was a cross-sectional study using secondary data, we could not use temporal order to determine the direction of causality. In other words, reverse causation cannot be totally ruled out in the relationship among discrimination, presenteeism, and cardiovascular disease [1]. For example, workers with cardiovascular disease may experience more discrimination or presenteeism in the workplace due to illness. Also, as mentioned earlier, the inability of the response to cardiovascular disease to distinguish between the existing condition and the new occurrence of the disease can make the possibility of reverse causation. Therefore, the results of this study do not necessarily explain the occurrence of new cardiovascular diseases due to discrimination or presenteeism. However, in this study, the experience period of discrimination, prescribing, and cardiovascular disease is all the same as 12 months. The association between these variables experienced at the same period can be assumed to be unmedicated or worsened by existing conditions, as described in the previous study [15]. In addition, asking the reason for discrimination that respondents think also reduces the possibility of reverse causation.

Second, cardiovascular disease was ascertained based on questionnaire responses rather than a physician's diagnosis or a medical record review, and could be an important limitation [34]. Especially, the use of this questionnaire prevented adjustment of the various risk factors of cardiovascular disease by variables other than general and occupational characteristics [35]. Furthermore, the existing cardiovascular disease or underlying risk factors of cardiovascular diseases, such as hypertension and obesity, were not ascertained in the 4th KWCS, and could not be controlled in this study. Various studies have evaluated these factors and their health effects in working conditions surveys [19,22,25,27,36-38]. Further studies should identify cardiovascular disease by direct examination or review of medical records.

Third, the measurement of discrimination was limited in that it evaluated perceived discrimination. A comparative study of discrimination, sexual harassment, and violence in Korea and Europe found that the threshold for unfair treatment varied from culture to culture [26], and the measurement of discrimination by questionnaire may not be accurate [20]. It is possible that actual discrimination is identified by the individuals who experience it as, for example, work stress, an unsatisfactory work environment, and depression rather than as discrimination per se. Therefore, future studies should focus on individual-level discrimination, the objective and structural problems of the working environment, and the measurement methods used in such research.

Lastly, because of the nature of this questionnaire study, differential misclassification of outcomes, in the form of reporting bias could have been possible. Especially, those who were subject to presenteeism in the workplace, may have not reported the cardiovascular disease, and more reporting bias could have arisen from this false negative response. However, if the reporting bias had occurred, especially among those subject to presenteeism, then the direction of bias should have been to lower, rather than to artificially increase, the association. Based on the direction of this potential reporting bias of those subject to presenteeism at workplace, we could safely assume that the true association of this study should have been much stronger.

Despite these limitations, this study is important for the following reasons. First, this study used the secondary data including a large population, so the sample was large enough to represent Korean employees. Second, this study used cardiovascular disease as a variable, and this has rarely been treated as health outcome of discrimination, especially in previous Korean studies. Although the use of self-reports of cardiovascular disease represents a limitation of our work, and a previous study used death from cardiovascular disease [29], we focused on only those individuals with a time of onset in the previous 12 months.

Third, this study compared the ORs for each type of discrimination before and after correction for confounding variables and calculated the ORs according to different types and combinations of discrimination to elucidate the different effects of multiple types of discrimination on health.

Last, to our knowledge, we used presenteeism, which was treated only as a health outcome in previous studies, as a social determinant of health (cardiovascular disease) in combination with discrimination for the first time. Previous discrimination research did not fully reflect the objective characteristics of the organizations studied. Presenteeism is determined by task or workplace characteristics rather than individuals (i.e., it is an indicator of group health) [6,7]. We believe that perceived discrimination may be related to health as a function of presenteeism, which reflects group health. In the future, discrimination should be prevented, a workplace culture that allows sufficient rest for sick workers should be fostered, and the characteristics of the workplace should be evaluated in occupational health examinations.

CONCLUSIONS

In conclusion, we report a significant association of discrimination and presenteeism with cardiovascular disease. Additionally, significant correlations were also found in cases in which multiple types of discrimination were experienced in conjunction with presenteeism.

Because of the limitations in the definition of cardiovascular diseases based on self-reported questionnaire response, the generalizability of this study results should be interpreted cautiously in terms of the mechanism of the specific cardiovascular diseases. It is necessary to reduce discrimination and presenteeism in the workplace to improve workers' health and identify objective indicators of the health effects of organizational characteristics.

ACKNOWLEDGMENTS

SUPPLEMENTARY MATERIALS

Supplementary Table 1
Distribution of discrimination and presenteeism by cardiovascular disease (male)

Click here to view

Supplementary Table 2
Distribution of discrimination and presenteeism by cardiovascular disease (female)

Click here to view

Supplementary Table 3
ORs of discrimination and presenteeism for cardiovascular disease (male)

Click here to view

Supplementary Table 4
ORs of discrimination and presenteeism for cardiovascular disease (female)

Click here to view

Supplementary Table 5
ORs of multiple types of discrimination with presenteeism for cardiovascular disease (male)

Click here to view

Supplementary Table 6
ORs of multiple types of discrimination with presenteeism for cardiovascular disease (female)

Click here to view

Supplementary Table 7

Distribution of discrimination and presenteeism by cardiovascular disease (younger than 55 years old)

Click here to view

Supplementary Table 8

Distribution of discrimination and presenteeism by cardiovascular disease (55 years old or older)

Click here to view

Supplementary Table 9

ORs of discrimination and presenteeism for cardiovascular disease (younger than 55 years old)

Click here to view

Supplementary Table 10

ORs of discrimination and presenteeism for cardiovascular disease (55 years old or older)

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Supplementary Table 11

ORs of multiple types of discrimination with presenteeism for cardiovascular disease (younger than 55 years old)

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Supplementary Table 12

ORs of multiple types of discrimination with presenteeism for cardiovascular disease (55 years old or older)

Click here to view

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