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Original Article

Relationship of Occupational Category With Risk of Physical and Mental Health Problems

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ABSTRACT

Objectives: We evaluated the physical and mental health problems of waged workers in Korea who had different classes of occupation.
Methods: We used data from the Korean National Health and Nutrition Examination Survey (2007–2017) to examine 22,788 workers who were waged employees and categorized these workers into 5 occupational classes.
Results: "Unskilled manual workers" were more likely to be older, less educated, have lower monthly income, and work fewer hours per week. Among men and relative to "managers and professionals" (reference group), "skilled manual workers" were more likely to have physician-diagnosed osteoarthritis, "clerks" were less likely to report suicidal ideation, and "unskilled manual workers" were more likely to report suicidal ideation. Among women and relative to "managers and professionals" (reference group), "service and sales workers" and "unskilled manual workers" were more likely to report physician-diagnosed osteoarthritis, depressive feelings, and suicidal ideation. However, hypertension, hyperlipidemia, diabetes, and cardiovascular diseases did not differ among the occupational classes for men and women.
Conclusion: We identified differences between men and women and among those in different occupational classes regarding employment status, physical health, and mental health. "Unskilled manual workers" of both genders were more likely to be older, less educated, have less monthly income, work fewer hours per week, and have suicidal ideation. Female "service and sales workers" were more likely to have osteoarthritis, depressive feelings, and suicidal ideation.
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1. Introduction

Work is one of the major social determinants of health, and it can improve or worsen health by several different mechanisms [1]. Employment provides a source of income and socioeconomic status in the community, and these can improve health. Work also helps an individual to develop identity and self-esteem and to form social networks outside the family [2]. However, work can also adversely affect health if the pay is poor or if it lowers self-esteem. Work can also adversely affect the health of individuals who are exposed to occupational hazards (physical, chemical, biological, ergonomic, and psychosocial factors) [3] and who have job insecurity or sedentarism [4,5].

Previous researchers have used various types of occupational categorizations, such as "white collar" and "blue collar," in assessments of the associations of occupations with health. "Pink collar" refers to nonmanual workers who mainly perform administrative, clerical, secretarial, or service and sales work [6], and "green collar"

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refers to manual workers employed in agriculture, fishing, and forestry [7–9]. Other researchers have categorized occupations solely by skill level: managers and professionals (Level 1); technicians and paraprofessionals (Level 2); tradespersons, advanced clerical and sales or service workers (Level 3); intermediate clerical, sales or service workers, and intermediate plant operators/transport workers (Level 4); and elementary clerical, sales or service workers, and laborers or related workers (Level 5) [2]. However, this categorization does not consider physical demands or other job characteristics, such as customer contacts, job insecurity, and sedentarism. Thus, there is no single best categorization of occupations; different categorizations are appropriate for examining different hypothesis. For example, sales or service occupation can be differentiated from clerical occupation because only sales or service occupation require emotional labor, defined as "the management of feelings to create a publicly observable facial and bodily display" [10], and may also require more physically demanding activities than other nonmanual work. Elementary occupations (unskilled manual work) can be differentiated from skilled manual work (other blue-collar or green-collar workers) because unskilled manual workers are more likely to be older, less educated, have less monthly income, work fewer hours per week, and have less job security [11]. Therefore, we used 5 occupational classes in the present study: "managers and professionals," "clerks," "service and sales workers," "skilled manual workers," and "unskilled manual workers."

Previous research reported that morbidity and mortality differed among those in different occupational classes. For example, a US study found that manual workers reported poorer health and a more rapid decline of health with age than professional workers [12]. A Dutch study reported similar findings [13]. A Korean study [14] reported that poor self-rated health among nonstandard workers differed for those with professional and nonprofessional employment. A UK study found a lower mortality rate in the highest occupational class relative to the lowest class [15]. However, there is little known about the different physical and mental problems experienced by waged workers who are categorized into 5 standard occupational classes considered here. Our previous study showed that nonstandard workers in these 5 classes experienced different occupational safety and health (OSH) problems. In particular, relative to those in other occupational classes, unskilled manual workers were more likely to be older, less educated, have less monthly income, work fewer hours per week, have less job security, and report exposure to physical/chemical and ergonomic hazards and musculoskeletal pain [11]. However, our previous studies of health outcomes were confined to musculoskeletal symptoms (back pain, upper and low extremity pain) and used the Korean Working Conditions Survey. The present article used data from the Korean National Health and Nutrition Examination Survey (KNHANES), and thus, the health problems we considered were not limited to musculoskeletal symptoms but also included other noncommunicable diseases.

We hypothesized that South Korean employees in different occupational classes experience different health problems and that unskilled manual workers with low socioeconomic status are most vulnerable to OSH problems. Thus, we used data from the KNHANES 2007–2017 and multiple logistic regression with adjustment for covariates to determine whether waged workers in different occupational classes have different physical and mental health problems.

2. Methods

2.1. Design and data collection

This cross-sectional study used data from the KNHANES of 2007–2017, which included KNHANES IV (2007–2009), KNHANES V (2010–2012), KNHANES VI (2013–2015), and KNHANES VII (2016–2017). We used pooled data of four surveys to increase the sample size. These surveys were conducted annually by use of a rolling sample design that uses a complex, stratified, multistage probability cluster analysis of a representative sample of the noninstitutionalized civilian population in South Korea. Thus, the KNHANES is a large representative population study with rigorous quality controls. These surveys were performed by the Korean Centers for Disease Control and Prevention and the Korean Ministry of Health and Welfare and have three components: a health interview, a health examination, and a nutrition survey.

Kweon et al. [16] provided details on the design of the survey. Briefly, information on age, education, smoking history, alcohol intake, and exercise was collected during the health interview. Height and weight were recorded with the participants wearing light clothing and no shoes. Body mass index (BMI) was calculated as body weight (kg) divided by the square of height (m^2), and subjects were then classified as lean (BMI $<$ 18.5 kg/m^2), normal (18.5 $\leq$ BMI $<$ 25 kg/m^2), or obese (BMI $\geq$ 25 kg/m^2). Age at the time of the interview was categorized into five groups. Area of residence was categorized as urban (within an administrative division of a city) or rural (outside the administrative division of a city). Terminal education level was categorized as less than high school, high school, and college or higher. Household income was grouped into quartiles. Marital status was divided into married/cohabitating and other.

Smoking status (current smoker, past smoker, and never-smoker) was based on self-reported cigarette use. Never-smokers were those who had smoked fewer than 100 cigarettes in their lifetimes; subjects who smoked 100 or more cigarettes were classified as past or current smokers based on current smoking habits. Alcohol consumption, based on self-reported drinking behavior during the month before the interview, was recorded as average frequency of drinking (days per month) and amount ingested (mL) on each occasion. These data were then converted into amount of pure alcohol (g) consumed per day, and subjects were then categorized according to average daily alcohol consumption: nondrinker, light drinker (1–15 g), moderate drinker (16–30 g), and heavy drinker (>30 g). Regular exercise was defined as exercising at least 5 times per week (≥30 min per session) in moderate activities (swimming slowly, playing doubles tennis or volleyball, and participating in occupational or recreational activities while carrying light objects), or exercising at least 3 times per week (≥20 min per session) in vigorous activities (running, climbing, cycling fast, swimming fast, playing football, basketball, squash or singles tennis, jumping rope, and participating in occupational or recreational activities while carrying heavy objects). Suicidal ideation was based on an affirmative answer to the question: "Have you ever thought of killing yourself during the past year?" Feelings of depression were identified by an affirmative answer to a question regarding whether the respondent had experienced feelings of depression for 2 consecutive weeks or more during the past 12 months. Physical health status was identified by previous physician-diagnosed presence of diseases (e.g., hypertension, diabetes mellitus, dyslipidemia, stroke, myocardial infarction or angina, and osteoarthritis). Physical and mental health problems can vary widely in scope. The analysis of physical health problems focused on noncommunicable diseases, which negatively impact work ability and threaten the sustainability of employment [17]. The analysis of mental health problems focused on depression (which may be affected by performing emotional labor or by psychosocial factors) [18,19] and suicidal ideation [20] (which may be influenced by socioeconomic status or by the presence of a chronic disease).

2.2. Study subjects and definitions

Analysis was restricted to adults (≥19 years) who completed the health examination survey (n = 68,939). The study subjects were 22,788 workers classified as waged employees.

The 5 different categories of occupational class were: "managers and professionals and related workers," "clerks," "service and sales workers," "skilled manual workers," and "unskilled manual workers." First, labor was categorized as manual or nonmanual, and then manual labor was categorized as skilled or unskilled. Skilled manual workers thus include the following 3 of 9 major groups in the Korean Standard Classification of Occupations [21] and the International Standard Classification of Occupations [22]: "skilled workers related to agriculture, forestry and fisheries," "craft and related trade workers," and "workers related to equipment, machine operating and assembling." Unskilled manual work indicates "elementary occupations," as used in the Korean Standard Classification of Occupations [21], and the major group elementary occupations in International Standard Classification of Occupations [22]. Nonmanual workers were categorized into three occupational classes: "managers and professionals and related workers," "clerks," and "service and sales workers." "Service and sales workers" are mainly those who perform emotional labor, defined as "the management of feelings to create a publicly observable facial and bodily display" [10] and perform some physically demanding activities, as well as nonmanual labor; this category thus differs from other nonmanual work that also has cognitive demands, such as "managerial and professional work" and "clerical work." "Service and sales workers" often work in small shops, shopping malls, banks, hotels, and restaurants [23].

After explanation of the survey, all participants provided written informed consent for participation. This survey was approved by the Institutional Review Board of the Korean Centers for Disease Control and Prevention (approval nos. 2007-02CON-04-P, 2008-04EXP-01-C, 2009-01CON-03-2C, 2010-02CON-21-C, 2011-02CON-06-C, 2012-01EXP-01-2C, 2013-07CON-03-4C, 2013-12EXP-03-5C).

2.3. Data analysis

Statistical analyses were performed using SAS (Version 9.4, SAS Institute, Cary, NC, USA) and SUDAAN (Release 11.0, Research Triangle Institute, Research Triangle Park, NC, USA), a software package that incorporates sample weights and adjusts analyses for complex sample design. Survey sample weights were used in all analyses to produce estimates that were representative of the noninstitutionalized civilian population of South Korea.

The chi-square test was used to compare categorical variables for the 5 occupational categories. Gender-specific analysis was used because men and women may differ in the following: occupational class, tasks, and hazards to which they are exposed; physical, physiological, and psychological responses to identical risk factors; and expression of pain and use of coping strategies to manage psychosocial stressors [24,25].

Multiple logistic regression was used to determine the odds ratios (ORs) and 95% confidence intervals (95% CIs) of self-reported physical and mental health for those in different occupational categories, with adjustment for age, marital status, BMI, socioeconomic factors (education, income, weekly working hours, and residence area), and health-related behaviors (smoking, alcohol consumption, and regular exercise). A *P*-value below 0.05 was considered significant.

3. Results

3.1. Characteristics of male and female workers

Table 1 presents an overview of the demographics, socioeconomic status, and health-related behaviors of the study population, grouped by occupational categories and gender. Among men, 23.9% were "managers and professionals," 21.9% were "clerks," 10.8% were "service and sales workers," 28.3% were "skilled manual workers," and 15.1% were "unskilled manual workers." Among women, 24.8% were "managers and professionals," 20.2% were "clerks," 23.6% were "service and sales workers," 6.0% were "skilled manual workers," and 25.4% were "unskilled manual workers."

For male workers, a higher proportion of aged workers (at least 60 years) performed unskilled manual work, a higher proportion of less-educated workers performed manual labor than nonmanual labor, a higher proportion of workers with the highest monthly income were "managers and professionals," and a higher proportion of those with the lowest monthly income were "unskilled manual workers." A higher proportion of workers with weekly working hours less than 40 were "unskilled manual workers." Higher proportions of obese workers were "managers and professionals" and "clerks"; higher proportions of current smokers were "service and sales workers" and "skilled manual workers"; higher proportions of heavy drinkers were "clerks," "service and sales workers," and "skilled manual workers"; and a higher proportion of those performing exercise were nonmanual workers. A smaller proportion of married workers were "service and sales workers," and a higher proportion of those living in rural areas were manual workers.

For female workers, a higher proportion of younger workers (less than 40 years) were "managers and professionals" and "clerks," a higher proportion of aged workers (at least 60 years) were "unskilled manual workers," a higher proportion of less educated workers performed manual than nonmanual labor, a higher proportion of workers with the highest monthly income were "managers and professionals," and a higher proportion of workers with the lowest monthly income were "unskilled manual workers." A higher proportion of those with less than 40 weekly working hours were "unskilled manual workers." A higher proportion of obese workers were manual workers, a higher proportion of current smokers were "service and sales workers," a higher proportion of heavy drinkers were "service and sales workers," and higher proportions of those performing exercise were "managers and professionals" and "clerks." Smaller proportions of married workers were "managers and professionals" and "clerks" and a higher proportion of those living in rural area were manual workers.

3.2. Health status of male and female workers

Table 2 shows ORs and 95% CIs for having previous physician-diagnosed diseases by occupational class, relative to "managers and professionals" (reference group). This analysis adjusted for confounding by age, marital status, BMI, socioeconomic factors, and health-related behaviors. Among men, "skilled manual workers" were more likely to have physician-diagnosed osteoarthritis (OR = 2.05, 95% CI = 1.30 to 3.25), "clerks" were less likely to report suicidal ideation (OR = 0.68, 95% CI = 0.47 to 0.97), and "unskilled manual workers" were more likely to report suicidal ideation (OR = 1.55, 95% CI = 1.06 to 2.26). However, hypertension, hyperlipidemia, diabetes, cardiovascular diseases, and depressive feelings did not differ among occupational classes.

Among women and relative to "managers and professionals" (reference group), "service and sales workers" (OR = 1.64, 95% CI = 1.10 to 2.47) and "unskilled manual workers" (OR = 1.73, 95%

Table 1
Demographics, socioeconomic status, and health-related behaviors of the study population by occupational class

Classification		Men						Women					
		Managers and professionals (N = 2783)	Clerks (N = 2555)	Service and sales workers (N = 1262)	Skilled manual workers (N = 3299)	Unskilled manual workers (N = 1757)	Subtotal (N = 11,656)	Managers and professionals (N = 2733)	Clerks (N = 2225)	Service and sales workers (N = 2604)	Skilled manual workers (N = 665)	Unskilled manual workers (N = 2796)	Subtotal (N = 11,023)
Age	19-29	359 (18.9)	282 (15.9)	472 (46.6)	313 (13.5)	223 (22.4)	1649 (20.6)	835 (38.1)	707 (40.3)	522 (26.1)	60 (12.3)	87 (5.5)	2211 (26.9)
	30-39	969 (36.0)	951 (38.1)	329 (24.0)	877 (27.8)	151 (11.9)	3277 (29.6)	942 (31.1)	750 (29.4)	421 (15.5)	112 (17.7)	218 (8.5)	2443 (21.1)
	40-49	782 (26.8)	776 (29.1)	270 (18.0)	923 (29.5)	202 (15.3)	2953 (25.6)	658 (22.3)	532 (21.9)	691 (27.4)	236 (39.2)	522 (23.6)	2639 (24.8)
	50-59	451 (13.9)	400 (13.7)	144 (9.4)	797 (22.1)	365 (21.8)	2157 (16.7)	241 (7.3)	191 (7.2)	704 (24.1)	180 (24.4)	812 (30.7)	2128 (17.6)
	60-	222 (4.3)	146 (3.2)	47 (2.0)	389 (7.1)	816 (28.5)	1620 (7.6)	57 (1.2)	45 (1.2)	266 (7.0)	77 (6.4)	1157 (31.8)	1602 (9.7)
Education	< High school	227 (8.0)	396 (15.0)	332 (25.8)	1919 (57.7)	1216 (61.9)	4090 (33.1)	255 (9.2)	582 (25.9)	1531 (56.9)	526 (78.9)	2411 (84.6)	5305 (45.3)
	High school	395 (15.9)	473 (18.7)	359 (30.0)	899 (27.2)	273 (18.3)	2399 (21.9)	607 (23.8)	625 (29.3)	604 (23.2)	103 (15.2)	275 (10.6)	2214 (21.4)
	> High school	2161 (76.1)	1686 (66.2)	571 (44.1)	481 (15.0)	268 (19.7)	5167 (45.0)	1871 (67.0)	1018 (44.8)	469 (20.0)	36 (6.0)	110 (4.8)	3504 (33.3)
Income	Quartile 1	83 (3.5)	54 (2.0)	96 (8.8)	230 (6.5)	396 (18.4)	859 (6.6)	84 (3.0)	79 (3.8)	308 (11.6)	80 (10.5)	844 (26.4)	1395 (10.9)
	Quartile 2	369 (14.2)	428 (17.4)	323 (27.4)	998 (30.1)	642 (35.5)	2760 (23.8)	410 (16.4)	406 (18.0)	779 (30.8)	206 (29.4)	918 (32.6)	2719 (24.6)
	Quartile 3	861 (32.4)	874 (35.2)	437 (33.3)	1232 (39.0)	454 (29.5)	3858 (34.7)	876 (32.6)	749 (35.1)	858 (33.2)	221 (35.1)	659 (26.6)	3363 (32.1)
	Quartile 4	1451 (49.9)	1183 (45.5)	399 (30.5)	813 (24.3)	248 (16.6)	4094 (34.9)	1346 (48.1)	979 (43.1)	640 (24.4)	154 (25.0)	361 (14.4)	3480 (32.4)
Working hour	<40	1571 (54.5)	1469 (55.1)	719 (55.0)	1645 (45.2)	1065 (57.9)	6469 (52.4)	1941 (68.5)	1607 (69.5)	1908 (72.7)	368 (51.5)	2240 (77.7)	8064 (70.8)
	40-<48	470 (17.8)	504 (21.4)	180 (14.6)	551 (17.7)	196 (13.6)	1901 (17.6)	488 (18.8)	383 (18.9)	274 (11.2)	107 (17.5)	255 (10.1)	1507 (15.0)
	48- <60	571 (21.1)	472 (19.3)	249 (21.5)	761 (25.1)	228 (14.6)	2281 (21.1)	269 (11.4)	210 (10.4)	263 (10.0)	138 (21.7)	192 (7.7)	1072 (10.6)
	≥60	171 (6.6)	110 (4.2)	114 (8.9)	342 (12.0)	268 (13.9)	1005 (8.9)	35 (1.3)	25 (1.2)	159 (6.1)	52 (9.4)	109 (4.4)	380 (3.6)
Obesity	Lean	47 (1.6)	38 (1.5)	45 (4.6)	87 (2.7)	58 (3.4)	275 (2.5)	278 (10.8)	211 (11.1)	142 (6.7)	21 (3.8)	86 (3.1)	738 (7.7)
	Normal	1569 (56.9)	1506 (58.5)	751 (61.0)	2012 (60.5)	1133 (62.8)	6971 (59.6)	2024 (74.3)	1642 (72.5)	1772 (68.4)	436 (65.7)	1741 (62.9)	7615 (69.4)
	Obese	1167 (41.4)	1011 (39.9)	466 (34.4)	1200 (36.8)	566 (33.8)	4410 (37.9)	431 (14.8)	372 (16.4)	690 (24.9)	208 (30.5)	969 (34.0)	2670 (22.8)
Smoking status	Nonsmoker	800 (30.4)	557 (22.6)	284 (23.6)	540 (16.8)	356 (21.6)	2537 (22.8)	2479 (89.3)	1958 (86.5)	2199 (83)	592 (86.7)	2518 (87.9)	9746 (86.7)
	Past smoker	960 (30.9)	926 (35.1)	310 (22.2)	1077 (29.9)	716 (35.2)	3989 (31.0)	140 (6.0)	145 (7.5)	137 (5.6)	30 (5.7)	111 (4.7)	563 (5.9)
	Current smoker	1023 (38.7)	1072 (42.3)	668 (54.2)	1682 (53.3)	685 (43.2)	5130 (46.3)	114 (4.8)	122 (6.0)	268 (11.4)	43 (7.5)	167 (7.4)	714 (7.4)
Drinking status	No drink	380 (12.5)	179 (6.6)	93 (7.1)	355 (10.3)	324 (15.5)	1331 (10.3)	623 (20.8)	382 (15.4)	575 (20.2)	172 (23.5)	1121 (37.4)	2873 (23.3)
	Mild drink	1380 (50.8)	1238 (48.3)	594 (47.1)	1417 (43.0)	733 (44.7)	5362 (46.7)	1856 (68.7)	1569 (71.5)	1628 (62.7)	425 (65.5)	1441 (52.8)	6919 (64.1)
	Moderate drink	461 (16.4)	471 (18.5)	231 (18.8)	644 (19.2)	337 (17.9)	2144 (18.2)	168 (6.8)	185 (8.7)	241 (10.2)	49 (7.4)	170 (6.9)	813 (8.1)
	Heavy drink	562 (20.3)	667 (26.6)	344 (27.0)	883 (27.5)	363 (21.8)	2819 (24.8)	86 (3.7)	89 (4.4)	160 (7.0)	19 (3.6)	64 (3.0)	418 (4.5)
Exercise	Yes	781 (31.2)	745 (32.6)	356 (30.9)	743 (24.3)	377 (24.3)	3002 (28.6)	759 (30.8)	585 (28.9)	624 (25.9)	154 (26.4)	597 (24.6)	2719 (27.6)
	No	2002 (68.8)	1810 (67.4)	906 (69.1)	2556 (75.7)	1380 (75.7)	8654 (71.4)	1974 (69.2)	1640 (71.1)	1980 (74.1)	511 (73.6)	2199 (75.4)	8304 (72.4)
Marital status	Married	2249 (74.1)	2108 (76.9)	729 (49.4)	2786 (79.8)	1427 (69.7)	9299 (72.8)	1746 (57.1)	1404 (55.9)	2052 (73.4)	611 (88.8)	2706 (95.1)	8519 (71.1)
	Others	526 (25.9)	444 (23.1)	533 (50.6)	508 (20.2)	328 (30.3)	2339 (27.2)	986 (42.9)	821 (44.1)	550 (26.6)	54 (11.2)	88 (4.9)	2499 (28.9)
Residence	Urban	2504 (90.1)	2253 (88.9)	1113 (87.9)	2657 (80.8)	1378 (81.6)	9905 (85.7)	2470 (90.6)	1950 (88.8)	2235 (87.3)	518 (79.2)	2129 (79.6)	9302 (86.3)
	Rural	279 (9.9)	302 (11.1)	149 (12.1)	642 (19.2)	379 (18.4)	1751 (14.3)	263 (9.4)	275 (11.2)	369 (12.7)	147 (20.8)	667 (20.4)	1721 (13.7)

Table 2
Odds ratios (95% confidence interval) for having previous physician-diagnosed diseases by occupational class (reference; "managers and professionals") after adjustments for covariates

Health outcome	Occupational categories	Men	Women
Hypertension	Managers and professionals	Ref	Ref
	Clerks	0.94 (0.80-1.09)	1.00 (0.75-1.34)
	Service and sales workers	0.91 (0.73-1.13)	1.08 (0.82-1.42)
	Skilled manual workers	0.90 (0.75-1.07)	1.31 (0.92-1.85)
	Unskilled manual workers	0.96 (0.78-1.18)	1.07 (0.80-1.41)
Diabetes	Managers and professionals	Ref	Ref
	Clerks	0.91 (0.70-1.18)	1.33 (0.81-2.18)
	Service and sales workers	1.01 (0.70-1.45)	1.24 (0.75-2.04)
	Skilled manual workers	0.96 (0.73-1.28)	1.04 (0.57-1.89)
	Unskilled manual workers	0.86 (0.62-1.20)	1.34 (0.82-2.18)
Hyperlipidemia	Managers and professionals	Ref	Ref
	Clerks	1.03 (0.82-1.29)	0.89 (0.62-1.27)
	Service and sales workers	0.98 (0.70-1.36)	1.10 (0.78-1.54)
	Skilled manual workers	1.05 (0.81-1.37)	0.84 (0.53-1.34)
	Unskilled manual workers	0.79 (0.58-1.09)	1.10 (0.76-1.57)
Cardiovascular disease	Managers and professionals	Ref	Ref
	Clerks	1.26 (0.75-2.12)	0.43 (0.16-1.16)
	Service and sales workers	1.84 (0.98-3.48)	0.60 (0.29-1.24)
	Skilled manual workers	1.06 (0.65-1.74)	0.51 (0.20-1.34)
	Unskilled manual workers	1.00 (0.30-1.65)	0.58 (0.27-1.25)
Osteoarthritis	Managers and professionals	Ref	Ref
	Clerks	0.69 (0.41-1.18)	1.17 (0.72-1.88)
	Service and sales workers	1.33 (0.66-2.70)	1.64 (1.10-2.47)
	Skilled manual workers	2.05 (1.30-3.25)	1.42 (0.86-2.34)
	Unskilled manual workers	1.52 (0.94-2.45)	1.73 (1.15-2.60)
Depressive Feeling	Managers and professionals	Ref	Ref
	Clerks	0.84 (0.62-1.14)	1.16 (0.92-1.46)
	Service and sales workers	1.16 (0.82-1.63)	1.29 (1.03-1.61)
	Skilled manual workers	1.29 (0.97-1.73)	1.07 (0.77-1.50)
	Unskilled manual workers	1.25 (0.89-1.76)	1.34 (1.04-1.73)
Suicide ideation	Managers and professionals	Ref	Ref
	Clerks	0.68 (0.47-0.97)	1.27 (0.98-1.63)
	Service and sales workers	1.01 (0.68-1.50)	1.47 (1.15-1.89)
	Skilled manual workers	1.26 (0.89-1.79)	1.20 (0.81-1.77)
	Unskilled manual workers	1.55 (1.06-2.26)	1.92 (1.46-2.52)

BMI, body mass index.
Adjusted for age, marital status, education, income, weekly working hours, residence area, smoking, alcohol consumption, regular exercise, and BMI.

CI = 1.15 to 2.60) were more likely to have physician-diagnosed osteoarthritis. "Service and sales workers" (OR = 1.29, 95% CI = 1.03 to 1.61) and "unskilled manual workers" (OR = 1.34, 95% CI = 1.04 to 1.73) were more likely to report depressive feelings; "service and sales workers" (OR = 1.47, 95% CI = 1.15 to 1.89) and "unskilled manual workers" (OR = 1.92, 95% CI = 1.46 to 2.52) were more likely to report suicidal ideation. However, hypertension, hyperlipidemia, diabetes, and cardiovascular diseases did not differ among occupational classes.

4. Discussion

We found differences in the gender distribution and socioeconomic status of workers in each of the 5 types of occupational class examined here. In particular, most "skilled manual workers" were men and most "unskilled manual workers" were women. Men were less likely to be "service and sales workers," and women were less likely to be "skilled manual workers." "Unskilled manual workers" were more likely to be elderly, less educated, have a low income, and work fewer weekly hours. "Service and sales workers" and "clerks" were more likely to be younger. "Managers and professionals" were more likely to have more education and a higher income.

The present study also showed that hypertension, hyperlipidemia, diabetes, and cardiovascular diseases did not differ among occupational classes. Previous studies that examined the association of occupational categories with cardiovascular diseases had conflicting results. For example, Harvanek et al [5] found that different occupational categories had different risks for cardiovascular disease. Many studies in developed Western countries reported a greater risk of cardiovascular diseases among those classified as blue collar or service workers [26,27]. However, a recent Japanese study showed that individuals with high-status occupations, such those performing managerial or professional work, had a greater risk for cardiovascular disease than other groups [28]. A South Korean study also found that metabolic syndrome was more prevalent in individuals in higher occupational classes [29]. These discrepancies suggest that other factors, such as health-related behaviors and socioeconomic status, may be more important determinants for cardiovascular diseases than occupation. The present findings are supported by previous studies. In particular, the population attributable fraction for cardiovascular diseases was highest for smoking, followed by physical inactivity and socioeconomic status [27]. Furthermore, the relationship of cardiovascular disease with occupation is not as strong as its relationship with other socioeconomic status indicators, such as education and income [5].

Our results indicated that male "skilled manual workers" and female "service and sales workers" and "unskilled manual workers" were more likely to have physician-diagnosed osteoarthritis than "managers and professionals" of the same gender after adjustment for covariates. Osteoarthritis is a degenerative disease caused by mechanical wear and tear on joints. The well-known risk factors for knee osteoarthritis include advanced age, female gender, BMI, prior knee injury, ergonomic hazards in occupations, family history of osteoarthritis, and lower socioeconomic status [30]. Several studies reported associations between low level of educational attainment and osteoarthritis [30–32]. Other research indicated that the poverty rate of an individual's community is associated with self-reported arthritis independently of educational attainment [33–35]. Ergonomic hazards among "skilled and unskilled manual

workers" and "service and sales workers" may be associated with osteoarthritis, because we adjusted for age, education level, and income. Male "skilled manual workers" (rather than "unskilled manual workers") are more likely to perform repetitive and stereotypical physical movements and to adopt awkward postures related to their skills; in contrast, female "unskilled manual workers" (rather than "skilled manual workers"), such as cleaners and cooking assistants, have more physically demanding jobs. There are also fewer females who are "skilled manual workers" than "unskilled manual workers" Among female nonmanual workers, "service and sales workers" perform more physically demanding activities. Hence, male "skilled manual workers" and female "service and sales workers" and "unskilled manual workers" were more likely to be exposed workplace ergonomic hazards and hence have an increased risk of osteoarthritis. The present findings are in agreement with those of Callahan [30], in that manual workers and service workers had greater risks of osteoarthritis. A previous South Korean study also found that the prevalence rate of osteoarthritis was most associated with the occupational category of "green collar," followed by "blue collar," "pink collar," and "white collar" [8].

We found that female "service and sales workers" were more likely to report depressive feelings after adjustment for covariates, probably because these types of occupational class entail emotional labor [10]. Female "unskilled manual workers" were also more likely to report depressive feelings. Job insecurity is common for "unskilled manual workers" [36], and this could contribute to their depressive feelings [4]. In agreement, a longitudinal study in the USA found that workers with precarious employment were more likely to have depressive symptoms [37].

Our results indicated that female "service and sales workers" and "unskilled manual workers" were also more likely to report suicidal ideation after adjustment for covariates. This may be because "service and sales workers" perform emotional labor. A previous study, which controlled for age, household income, and employment characteristics, showed that workers who suffered from high emotional demands were more likely to experience suicidal ideation [38]. "Unskilled manual workers" (considered to be precarious workers) may have increased suicidal ideation because of their job insecurity. In support of this interpretation, a previous South Korean study linked part-time or contingency employment with suicidal ideation and suicide attempts [39], and a previous Canadian study found that individuals with part-time work were more likely to attempt suicide [40]. Notably, our findings are also in line with previous studies which reported that about 90% of suicidal subjects had a diagnosis of at least one mental health problem [41] and that patients with depressive disorders had a greater risk for suicide than the general population [42].

We also found differences in the prevalence of osteoarthritis, depressive feelings, and suicidal ideation among males and females in different occupational classes. This may be because men and women differ in the types of occupations they perform, the tasks they perform even when they are in the same occupation, and the occupational hazards to which they are exposed. Men and women may also differ in their physical, physiological, and psychological responses to identical risk factors and their expression of pain and use of coping strategies to manage psychosocial stressors [24,25].

The present study is the first to evaluate the socioeconomic conditions and the physical and mental health status of waged workers who have different types of occupations. In particular, "unskilled manual workers" were more likely to be female, older, less educated, have less monthly income, work fewer hours per week, and have poor physical and mental health status. The health of workers is determined by several factors: health-related behaviors, such as lifestyle; occupational hazards; social factors, such as employment status, stability of work, income, or inequities associated with gender, race, and age; and access to healthcare services [43]. We found that unskilled manual workers were more likely to be elderly, have lower socioeconomic status, and have job insecurity. Our previous study showed that unskilled manual workers were more likely to report exposure to physical/chemical and ergonomic hazards and musculoskeletal pain, relative to nonmanual workers [11]. Individuals with precarious employment have limited access to occupational and general health care services [17]. Taken together, our results indicated that social determinants were the main factors responsible for the poor physical and mental health status of unskilled manual workers. These findings are supported by previous studies which found that low social and economic status (less education, lower income, and unstable job) directly or indirectly contribute to poor health status [44–46].

There are several public health implications of our results. First, our findings suggest that health inequities could be reduced by implementation of OSH programs that specifically target "unskilled manual workers," most of whom are not covered by current OSH programs in South Korea. Furthermore, OSH programs should be customized for workers in different occupational classes. Second, our results suggest that "service and sales workers" and "unskilled manual workers" have higher risk for suicide. In South Korea, suicide is a major social issue, and the suicide rate has increased dramatically during recent decades, growing from 13.0 per 100,000 in 1997 to 33.3 per 100,000 in 2011 and 25.8 per 100,000 in 2016. The suicide rate in South Korea is the highest among countries in the Organization for Economic Cooperation and Development [47,48]. Thus, suicide prevention should be implemented as a part of workplace health promotion.

Our study had several strengths. First, we examined a large and representative sample of the South Korean working population and used rigorous quality-control procedures. Second, we examined the physical and mental health status of individuals who had different types of occupations. Third, we adjusted for confounding by age, marital status, BMI, socioeconomic factors (education, income, weekly working hours, and residence area), and health-related behaviors (smoking, alcohol consumption, and regular exercise). Finally, we classified labor as manual or nonmanual, manual labor as skilled or unskilled, and nonmanual workers as "managers and professionals," "clerks," or "service and sales workers." This occupational classification is supported by our findings that the physical and mental health problems of workers vary among those in these 5 occupational classes.

Our study also had some limitations. First, we used self-reported data, instead of objective findings. Some misclassification is possible, so these data should be interpreted with caution. Second, our results are based on cross-sectional analysis. Therefore, we did not identify temporal relationships of the different variables and cannot establish causality for the reported associations. Some of the associations we identified could be explained by the "healthy worker effect" if individuals with pre-existing health conditions are more likely become "unskilled manual workers." However, several studies have examined this issue and found that work conditions were a more significant cause of poor health than poor health was a cause of poor work conditions [49].

In conclusion, we identified differences between men and women and among those in different occupational classes regarding employment status, physical health, and mental health. "Unskilled manual workers" were more likely to be older, less educated, have less monthly income, work fewer hours per week, and have suicidal ideation in both genders. Female "service and sales workers" were more likely to have osteoarthritis, depressive feeling, and suicidal ideation. Our findings suggest that OSH programs should be customized for workers in different occupational

classes and should also consider gender. For example, we believe that OSH programs should more specifically target “unskilled manual workers,” the class most vulnerable to OSH problems, and a class not covered by current OSH programs in Korea.

Ethics approval and consent to participate

The Institutional Review Board of the Korean Centers for Disease Control and Prevention approved this study (approval nos. 2007-02CON-04-P, 2008-04EXP-01-C, 2009-01CON-03-2C, 2010-02CON-21-C, 2011-02CON-06-C, 2012-01EXP-01-2C, 2013-07CON-03-4C, 2013-12EXP-03-5C). All participants provided written informed consent prior to participation.

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Author contributions

Y.K. & J.P. designed the study, made substantial contributions to conception, carried out data collection, and analyzed and interpreted data. J.A. assisted in data collection and was a major contributor in writing and editing the manuscript. N-.S.K. assisted in data collectionand was a major contributor in writing and editing the manuscript. B-.K.L. carried out data collection and analyzed. All authors read and approved the final manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

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