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Original Article

Occupational Class Inequalities in Behavioral and Biological Risk Factors for Cardiovascular Disease among Workers in Medium- and Small-scale Enterprises

Yuko MORIKAWA[1*], Masaji TABATA[2], Teruhiko KIDO[3] and Yoshiko KOYAMA[4]

[1] Department of Epidemiology and Public Health, School of Nursing, Kanazawa Medical University, Japan
[2] Ishikawa Health Service Associations, Japan
[3] Faculty of Medicine, School of Health Science, Kanazawa University, Japan
[4] Ishikawa Occupational Health Promotion Center, Japan Labor Health and Welfare Organization, Japan

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Abstract: The aim of this cross-sectional study was to examine whether occupational class inequalities existed in the behavioral and biological risk factors for cardiovascular disease among workers in medium- and small-scale enterprises. We asked 1,900 enterprises in the Ishikawa prefecture who were users of an external heath check-up facility to supply anonymous individual data in 2009. The 446 enterprises consented to the invitation. The study population was 12,625 individuals (8,104 males and 4,521 females) 16–59 yr of age. We compared indices among occupational classes. The indices of lipid and glucose metabolism were used only for subjects 40–59 yr of age. The results of this study revealed occupational class inequalities in the prevalence of current smoking, heavy drinking and hypertension in men. These inequalities were more prominent among men in the younger age group than in the older age group. In men, the most disadvantaged occupational class was transportation workers, followed by laborers. Occupational class inequalities in smoking were also found among female workers. However, the influences of occupational class on obesity and indices of lipid or glucose metabolism were inconsistent. A strategy for health promotion that targets the disadvantaged population is necessary for the prevention of cardiovascular disease.

Key words: Socioeconomic status, Occupational class, Cardiovascular disease, Risk factor, Health behavior, Blood pressure, Small-scale enterprises

Introduction

Behavioral and biological risk factors for cardiovascular diseases have been established in Japan[1, 2]. A significant reduction in stroke mortality and incidence as well as the prevention of increased coronary heart disease mortality and incidence has been achieved by controlling major risk factors, particularly lowering blood pressure and cessation of smoking rate[3, 4]. However, cardiovascular diseases are still create major health and financial burdens in Japan[4, 5], and reducing risks has been an important issue also for occupational health[6].

Differences in rates of cardiovascular disease morbidity and mortality among occupational classes are consistent

*To whom correspondence should be addressed.
E-mail: ymjr@kanazawa-med.ac.jp

findings in epidemiological studies in European countries and the US[7–16]. Inequalities in rates of well-known risk factors for cardiovascular disease among occupational classes were reported, and their contributions to differences in rates of cardiovascular disease morbidity and mortality were also estimated[8–10, 13, 16, 17].

However, there is only limited evidence of socioeconomic inequalities in rates of cardiovascular disease and its risk factors in Japan[18]. Japan was considered to have a relatively small degree of socioeconomic disparity within its population[19, 20]. A cohort study of data from a large-scale enterprise did not reveal significant occupational class inequalities in the incidence of cardiovascular events[21]. For cardiovascular risk factors, health inequalities for behavioral risks have been established in Japan. An analysis of a national representative sample of individuals 25 to 59 yr of age found that lower occupational class was a substantial predictor of risk behavior in both sexes[22]. A comparative study between Japan and England, which consisted of employees of large-scale companies and civil servants, showed that smoking and heavy drinking were more prevalent among the lower occupational social classes than the higher occupational social classes in both populations[23]. However, for biological cardiovascular risk factors, health inequalities have not been established in Japan.

Ninety percent of the workers in Japan are employed in small- or medium-sized enterprises[24]. In general, occupational health activities are less sufficient in smaller-scale enterprises[25, 26]. A higher prevalence of hypertension, obesity, and smoking in male workers in smaller enterprises compared to those in larger organizations was also reported in Japan[27]. Therefore, the tendencies of occupational class inequalities in smaller-scale enterprises might be different from those in large-scale enterprises. However, as far as we know, there is no study on health inequalities that targets employees engaged in medium-sized or small-sized enterprises.

The present cross-sectional study was designed to determine whether occupational class differences existed in the prevalence of cardiovascular risk factors among workers in medium- and small-scale enterprises. It would be helpful for making health promotion program in workplace.

Methods

Ethics statement

The ethics committee of the Association of Health and Welfare for Workers, Japan, approved this study.

Subjects and materials

The target population was workers in medium-scale or small-scale enterprises (<300 employees). We invited 1,900 enterprises in the Ishikawa prefecture who were users of an external health check-up facility. We chose the enterprises based on the following characteristics: the external facility contracted with the enterprises for health check-ups for all of the employees of each enterprise, and the number of participants who had a health check-up in 2009 was less than 300 employees. We excluded enterprises that were known to be branches of large-scale enterprises. We explained the purpose and privacy policy of this study, and we asked the enterprises to supply anonymous individual data from screening examinations of employees in 2009 and to answer a questionnaire regarding the characteristics of the enterprise, including exact scale (number of employees), independence, and type of business. The number of enterprises that consented to the invitation with signed documentation was 473 (25.1%). Since 27 enterprises were confirmed as branches of large-scale enterprises or larger-scale enterprises by a questionnaire, they were excluded from the analysis. Therefore, 446 enterprises, consisting of 133 manufacturing industries, 94 construction companies, 36 transportation businesses, 46 wholesale/retail industries, 25 medical services, 52 other service industries and 60 others, remained. Employees younger than 60 yrs of age (N=12,706 subjects; 8,168 males and 4,538 females) in those enterprises were the subjects of this study.

For analysis, we used health behaviors, anthropometric indices and laboratory data that are known cardiovascular risk factors. According to the Industrial Safety and Health Act, the owners of the enterprises are responsible for carrying out health checkups for employees, but a blood test is not crucial for employees under 40 yr of age, except at age 35. A large number of the 7,280 subjects younger than 40 yr of age, 1,729 (23.8%), did not have a blood test. Therefore, in the following analysis, we did not use laboratory variables for subjects younger than 40 yr of age. Eighty-one subjects 40–59 yr of age who did not have laboratory data were excluded. Consequently, a total of 12,625 subjects (8,104 males and 4,521 females) were the subjects for analysis. The mean age of the subjects was 38.8 ± 10.5 yr (range; 16–59 yr) for men and 38.0 ± 11.1 yr (range; 18–59 yr) for women.

The subjects were classified into the following 5 occupational classes: 1) managerial workers/professional workers, 2) clerical workers, 3) service workers/sales workers, 4) transport workers, and 5) laborers (manufacturing process workers, construction workers, and carrying and packaging workers) according to the Japan Standard Occupational Classification (Rev, 5th, 2009)[28].

Variables and definition of positive findings

We used health behaviors including smoking and alcohol drinking, anthropometric indices including BMI (kg/m^2), waist circumference and blood pressure, and laboratory variables including serum total cholesterol, low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol, triglycerides, blood glucose and glycohemoglobin A1c (HbA1c). Among subjects 40–59 yr of age, 2,426 fasting blood samples and 2,919 casual blood samples were obtained.

Smoking status was categorized as current, ex-smokers, and never smokers. Alcohol consumption was assessed via questions on the number of alcoholic drinks consumed in a week. This was converted to the number of alcohol units (1 unit corresponded to 28 g alcohol) consumed per week. Subjects were categorized as heavy drinkers (>12 units/wk) and light or moderate drinkers (1 to ≤12 units/wk) and no or occasional drinkers (<1 unit/wk).

Obesity was defined as a BMI of ≥25 kg/m^2. Hypertension was defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg, or use of antihypertensive medication. Dyslipidemia was defined as total cholesterol ≥240 mg/dl and/or LDL cholesterol ≥140 mg/dl and/or HDL cholesterol <40 mg/dl and/or triglycerides (TG) ≥300 mg/dl, or use of lipid metabolic agents. Hyperglycemia was defined as HbA1c (JDS: Japan Diabetes Society) ≥6.1% and/or fasting blood glucose ≥126 mg/dl and/or casual blood glucose ≥180 mg/dl, or use of hypoglycemic agents. Metabolic syndrome was defined as abdominal obesity (waist circumference ≥85 cm for men, ≥90 cm for women) accompanied by two or more of the following 3 components: high blood pressure (SBP ≥130 mmHg and/or DBP ≥85 mmHg or use of antihypertensive medication), dyslipidemia (HDL cholesterol<40 mg/dl and/or TG ≥150 mg/dl, or use of lipid metabolic agents) and hyperglycemia (fasting blood glucose ≥110 mg/dl, or use of hypoglycemic agents) according to the criteria of the Japanese Committee to Evaluate Diagnostic Standards for Metabolic Syndrome[29]. However, in the definition of metabolic syndrome, TG ≥150 mg/dl was used irrespective of fasting or casual sample, and HbA1c ≥5.5% was used only for casual samples. The cut of point, 5.5% of HbA1c, was followed the criteria used in the report of National Health and Nutrition Survey[30].

Data analysis

The associations of occupational class with each factor were examined in the subpopulations stratified by age group and sex. For men, comparisons were carried out among 5 occupational classes. For women, comparisons were carried out among 4 occupational classes. Since the number of female transportation workers was too small, these individuals were included in the “laborers” group.

The prevalence of health behaviors and the mean values of the parameters were compared among occupational classes with the χ^2 test or one-way analysis of variance with Scheffé’s post-hoc comparison test. Logistic regression analysis was used to examine the association of occupational class with positive findings of cardiovascular risks—smoking, heavy drinking obesity, hypertension, dyslipidemia, hyperglycemia, and metabolic syndrome. Age was put into the model using dummy variables: <25 yr of age (reference), 25–29 yr, 30–34 yr, 35–39 yr, 40–44 yr, 45–49 yr, 50–54 yr, and 54–59 yr.

Analyses were performed with SPSS 19.0 software (SPSS Inc., Chicago, IL, USA). All probability values were two-tailed, and the level of statistical significance was set at $p<0.05$.

Results

The distributions of occupational classes, type of business and size of enterprise are shown in Table 1. There were 1,717 males and 686 females in the managerial/professional workers class, 1,447 males and 1,612 females in the clerical workers class, 652 males and 963 females in the service/sales workers class, 906 males and 38 females in the transport workers class, and 3,352 males and 1,222 females in the laborers class.

Results of comparisons of characteristics among occupational classes for men are shown in Table 2. For men 16–39 yr of age, all parameters were significantly different among occupational classes. The items that were significantly higher than those of the managerial/professional class by post-hoc test were as follows: SBP of laborers and transportation workers, DBP of clerical workers, and current smoking among transportation workers and laborers. Heavy drinking was more prevalent among transportation workers. Among men 40–59 yr of age, all parameters except DBP were significantly different among occupational classes. The items that were significantly higher than those of the managerial/professional class by post hoc test were as follows: SBP of transportation workers, smoking among laborers and transportation workers, and heavy drinking

Table 1. Characteristics of subjects

	Overall	Men	Women
Total	12,625 (100.0)	8104 (100.0)	4521 (100.0)
Age group			
<40 yr of age	7280 (57.7)	4671 (57.6)	2609 (57.7)
40–59 yr of age	5345 (42.3)	3433 (42.4)	1912 (42.3)
Occupational class			
Managerial/professional	2403 (19.0)	1717 (21.2)	686 (15.2)
Clerical	3089 (24.5)	1477 (18.2)	1612 (35.7)
Service/sales	1615 (12.8)	652 (8.0)	963 (21.3)
Transportation	944 (7.5)	906 (11.2)	38 (0.8)
Laborer	4574 (36.2)	3352 (41.4)	1222 (27.0)
Type of business			
Manufacturing	4241 (33.6)	2747 (33.9)	1494 (33.0)
Construction	1591 (12.6)	1373 (16.9)	218 (4.8)
Transportation	1042 (8.3)	889 (11.0)	153 (3.4)
Wholesale/retail	1492 (11.8)	860 (10.6)	632 (14.0)
Medical service	751 (5.9)	157 (1.9)	594 (13.1)
Other service industry	1448 (11.5)	858 (10.6)	590 (13.1)
Others	2060 (16.3)	1220 (15.1)	840 (18.6)
Size of enterprise			
100–299 employees	4448 (35.2)	2811 (34.7)	1637 (36.2)
50–99 employees	2752 (21.8)	1624 (20.0)	1128 (25.0)
20–49 employees	3472 (27.5)	2269 (28.0)	1203 (26.6)
<20 employees	1953 (15.5)	1400 (17.3)	553 (12.2)

among service workers, laborers and transportation workers. On the other hand, BMI, waist circumference, and LDL cholesterol level were significantly lower among laborers compared with those in the managerial/professional class.

Results of comparisons of characteristics among occupational classes for women are shown in Table 3. For subjects 18–39 yr of age, all parameters were significantly different among occupational classes. The items that were significantly higher than those of the managerial/professional class by post-hoc test were as follows: SBP among laborers and smoking among service/sales workers and laborers. The prevalence of drinking was significantly different between subjects in the managerial/professional class and laborers, but the overall prevalence of heavy drinking was very low (0.8%). For women 40–59 yr of age, SBP, HDL cholesterol, and the prevalence of smoking were significantly different among occupational classes. The items that were significantly higher than those of the managerial/professional class by post-hoc test were as follows: SBP among laborers and smoking among service/sales workers.

Results of multivariate logistic regression models for men are shown by age group in Table 4. Managerial/professional workers were used as a reference. We found statistically significant relationships with occupational class and smoking, heavy drinking, obesity and hypertension in subjects 16–39 yr of age. All four parameters were more prevalent in transportation workers. The age-adjusted ORs for smoking were 2.73 (95%CI, 2.10–3.55) for transportation workers and 1.50 (95%CI, 1.28–1.76) for laborers. The age-adjusted ORs for heavy drinking were 2.92 (95%CI, 1.77-–4.84) for transportation workers, 1.93 (95%CI, 1.09–3.41) for service/sales workers and 1.73 (95%CI, 1.13–2.64) for laborers. The age-adjusted ORs for obesity were 1.52 (95%CI, 1.16–1.98) for transportation workers, 1.28 (95%CI, 1.03–1.59) for clerical workers. The age-adjusted ORs for hypertension were 1.66 (95%CI, 1.17–2.36) for transportation workers, 1.66 (95%CI, 1.24–2.21) for clerical workers and 1.55 (95%CI, 1.21–1.99) for laborers. Among subjects 40–59 yr of age, we found statistically significant relationships with occupational class and smoking and heavy drinking. The age-adjusted ORs for smoking were 1.88 (95%CI, 1.51–2.34) for transportation workers and 1.64 (95%CI, 1.37–1.96) for laborers. The age-adjusted ORs for heavy drinking

Table 2. Comparison of prevalence of behavioral factors and mean (SD) of physiological factors among occupational classes by age group (men)

Age group	Item	Overall	Managerial / professional	Clerical	Service/sales	Laborer	Transportation	p value
16–39 yr old		n=4671	n=899	n=843	n=413	n=2156	n=360	
	Body mass index (kg/m^2)[a)]	23.1 (3.7)	23.1 (3.1)	23.5 (3.9)	22.7 (3.7)	23.0 (3.8)	23.8 (4.0)	<0.001
	Systolic blood pressure (mmHg)[a)]	124.0 (12.2)	122.6 (11.7)	123.4 (12.5)	122.3 (11.6)	124.8 (12.1)*	125.8 (13.2)*	<0.001
	Diastolic blood pressure (mmHg)[a)]	72.4 (11.7)	72.2 (11.1)	74.1 (11.6)*	71.5 (11.1)	71.7 (11.8)	74.3 (12.9)	<0.001
	Cigarette smoking (%)							
	Never	31.9	36.6	33.5	35.4	31.2	16.7	
	Former	14.8	17.1	17.9	13.1	13.3	12.8	
	Current	53.3	46.3	48.6	51.6	55.6*	70.6*	<0.001
	Alcohol drinking (%)							
	No	51.3	46.4	45.0	55.0	56.0	46.1	
	Light or moderate	44.0	50.4	51.8	39.7	39.3	43.3	
	Heavy	4.7	3.2	3.2	5.3*	4.7*	10.6*	<0.001
40–59 yr old		n=3433	n=818	n=634	n=239	n=1196	n=546	
	Body mass index (kg/m^2)	23.9 (3.4)	24.2 (3.5)	24.2 (3.4)	23.7 (3.0)	23.4 (3.3)*	24.2 (3.6)	<0.001
	Waist circumference (cm)	85.2 (9.1)	86.2 (9.1)	86.5 (9.1)	84.3 (8.3)	83.8 (8.7)*	85.9 (9.8)	<0.001
	Systolic blood pressure (mmHg)[a)]	128.2 (15.9)	126.8 (15.3)	126.6 (15.5)	128.9 (16.8)	128.9 (16.0)	130.3 (16.6)*	<0.001
	Diastolic blood pressure (mmHg)[a)]	81.8 (11.7)	82.1 (11.1)	82.2 (11.4)	81.8 (11.7)	81.3 (11.9)	81.7 (12.2)	
	LDL cholesterol (mg/dl)[a)]	124.4 (34.0)	127.1 (34.7)	128.5 (33.6)	122.0 (32.6)	121.9 (33.8)	122.4 (33.8)	<0.001
	HDL cholesterol (mg/dl)[a)]	58.0 (15.9)	57.8 (16.2)	55.7 (14.4)	57.1 (14.9)	59.9 (16.5)	57.2 (15.7)	<0.001
	Cigarette smoking (%)							
	Never	18.3	22.2	19.1	20.5	17.1	13.2	
	Former	27.9	23.9	32.2	29.7	26.6	26.6	
	Current	52.1	43.9	48.7	49.8	56.4	56.4	<0.001
	Alcohol drinking (%)							
	No	33.1	31.8	32.2	37.2	33.3	33.9	
	Light or moderate	54.3	57.6	58.4	50.6	51.8	51.5	
	Heavy	12.6	10.6	9.5	12.1	14.9	14.7	0.004

[a)]: mean (SD, standard deviation). p value: one-way analysis of variance for continuous variables, χ^2 test for categorical variables. *<0.05: significantly different compared with managerial/professional class by post-hoc test (χ^2 test for categorical data and Scheffé test for continuous data). Heavy drinkers: >12 units/wk, Light or moderate drinkers: 1 to ≤12 units/wk, No: <1 unit/wk (1 unit corresponded to 28 g alcohol).

were 1.50 (95%CI, 1.14–1.97) for laborers and 1.46 (95%CI, 1.05–2.02) for transportation workers. Although the relationships of occupational class with obesity, dyslipidemia, and hyperglycemia were not consistent, the age-adjusted OR for metabolic syndrome among transportation workers, 1.31 (95%CI, 1.02–1.68) was significantly high.

Results of multivariate logistic regression models for women are shown in Table 5. Managerial/professional workers were used as a reference. Comparison of the prevalence of heavy drinking among occupational classes was not carried out, since the number of heavy drinkers was small in both age groups. We did not find clear relationships with occupational class for any of the risk factors, except for smoking. Among subjects 18–39 yr of age, the age-adjusted ORs for smoking were 2.10 (95%CI, 1.48–2.98) for service/sales workers and 1.86 (95%CI, 1.31–2.64) for laborers. Among the subjects 40–59 yr of age, the age-adjusted OR for smoking was 1.80 (95%CI, 1.23–2.63) for service/sales workers.

Discussion

The main aim of this cross-sectional study was to examine whether occupational class inequalities existed in the behavioral and biological risk factors for cardiovascular disease among workers in medium- and small-scale enterprises, a population that is representative of the major working population in Japan. We performed analyses of the study population stratified by age group and sex. The indices of lipid and glucose metabolism were used only for subjects 40–59 yr of age. In this study, we used the managerial/professional class, the highest occupational class, as a reference, and evaluated whether inequalities in health behaviors and biological factors were present.

Table 3. Comparison of prevalence of behavioral factors and mean (SD) of physiological factors among occupational classes by age group (women)

Age group	Item	Overall	Managerial / professional	Clerical	Service /sales	Laborer/ transportation	p value
18–39 yr old		n=2609	n=407	n=1042	n=595	n=565	
	Body mass index (kg/m^2)[a)]	20.9 (3.3)	21.1 (3.8)	20.6 (2.9)	20.7 (2.7)	21.6 (3.8)	<0.001
	Systolic blood pressure (mmHg)[a)]	111.1 (11.5)	110.3 (11.9)	110.7 (11.3)	110.2 (10.5)	113.5 (12.2)*	<0.001
	Diastolic blood pressure (mmHg)[a)]	67.1 (9.8)	67.0 (10.0)	67.5 (9.6)	65.8 (9.1)	68.1 (10.7)	<0.001
	Cigarette smoking (%)						
	Never	72.0	76.9	74.0	67.6	69.4	
	Former	10.2	9.8	11.1	10.1	8.8	
	Current	17.8	13.3	14.9	22.4*	21.8*	<0.001
	Alcohol drinking (%)						
	No	75.7	73.5	74.7	73.1	82.1	
	Light or moderate	23.5	26.0	24.9	25.9	16.6	
	Heavy	0.8	0.5	0.5	1.0	1.2*	0.001
40–59 yr old		n=1912	n=279	n=570	n=368	n=695	
	Body mass index (kg/m^2)	22.0 (3.4)	22.1 (3.4)	21.8 (3.3)	22.1 (3.5)	22.1 (3.5)	
	Waist circumference (cm)	78.9 (9.3)	78.6 (9.1)	78.6 (8.9)	79.0 (9.7)	79.2 (9.4)	
	Systolic blood pressure (mmHg)[a)]	119.4 (16.0)	117.7 (14.0)	117.8 (15.5)	119.1 (17.0)	121.5 (16.5)*	<0.001
	Diastolic blood pressure (mmHg)[a)]	74.8 (10.8)	74.0 (10.5)	74.8 (10.7)	74.8 (10.6)	75.0 (11.2)	
	LDL cholesterol (mg/dl)[a)]	119.5 (30.8)	117.9 (30.1)	119.8 (31.0)	119.7 (30.8)	119.9 (30.8)	
	HDL cholesterol (mg/dl)[a)]	71.2 (17.1)	73.0 (17.5)	70.6 (17.8)	72.6 (17.3)	70.1 (16.2)	0.029
	Cigarette smoking (%)						
	Never	71.7	68.8	78.2	58.7	74.2	
	Former	11.1	12.9	10.7	13.0	9.8	
	Current	17.2	18.3	11.1*	28.3*	16.0	<0.001
	Alcohol drinking (%)						
	No	70.0	68.1	67.2	68.2	74.1	
	Light or moderate	28.7	29.7	31.9	30.4	24.7	
	Heavy	1.3	2.2	0.9	1.4	1.2	

a): mean (SD, standard deviation). p value: one-way analysis of variance for continuous variables, χ^2 test for categorical variables. *<0.05: significantly different compared with managerial/professional class by post-hoc test (χ^2 test for categorical data and Scheffé test for continuous data). Heavy drinkers: >12 units/week, Light or moderate drinkers: 1 to ≤12 units/wk, No: <1 unit/wk (1 unit corresponded to 28 g alcohol).

We found clear occupational class inequalities in behavioral risks among men. Transportation workers and laborers showed higher rates of smoking and heavy drinking compared with managerial/professional workers. In the younger age group, service/sales workers also showed a higher prevalence compared with managerial/professional workers. For the biological factors, we found occupational class inequalities in blood pressure among men. Laborers and transportation workers showed higher blood pressure and a higher prevalence of hypertension compared with managers/professional workers. Inequalities in behavioral risks and hypertension were more prominent among those in the younger age group, and the most disadvantaged occupational class was transportation workers. Among female subjects, we found occupational class inequalities in smoking and blood pressure. However, the influences of occupational class on obesity and indices of lipid or glucose metabolism were inconsistent; clear occupational class inequalities were not found in both sexes.

These results for behavioral risks are similar to former studies in Japan. Fukuda *et al.*[22)], who used the 2001 Comprehensive Survey of the Living Conditions of People on Health and Welfare conducted by the Ministry of Health, Labor and Welfare, suggested that lower occupational class was a substantial predictor of risk behavior in both sexes. A comparative study between Japan and England also suggested that smoking and heavy drinking were prevalent among the lower occupational social classes in both populations[23)]. Lower socio-economic groups were generally found to smoke more cigarettes per day, and to quit smoking less often compared with higher socio-economic groups[31, 32)]. Although the overall prevalence of smoking has decreased among men in many countries, these changes have not occurred equally across all populations.

Table 4. Age-adjusted odds ratio of behavioral factors and positive findings of physiological data (Men)

Item	16–39 yr			40–59 yr		
Occupational class	%	OR	(95%CI)	%	OR	(95%CI)
Smoking						
Managerial/professional	46.3	1.00	Reference	43.9	1.00	Reference
Clerical	48.6	1.09	(0.91–1.33)	48.7	1.19	(0.96–1.46)
Service/sales	51.6	1.26	(1.00–1.60)	49.8	1.26	(0.94–1.68)
Laborer	55.6	1.50	(1.28–1.76)***	56.4	1.64	(1.37–1.96)***
Transportation	70.5	2.73	(2.10–3.55)***	59.7	1.88	(1.51–2.34)***
Heavy drinking						
Managerial/professional	3.2	1.00	Reference	10.6	1.00	Reference
Clerical	3.2	0.96	(0.56–1.65)	9.5	0.92	(0.65–1.30)
Service/sales	5.3	1.93	(1.09–3.41)*	12.1	1.19	(0.76–1.87)
Laborer	4.7	1.73	(1.13–2.64)*	14.9	1.50	(1.14–1.97)**
Transportation	10.6	2.92	(1.77–4.84)***	14.7	1.46	(1.05–2.02)*
Obesity						
Managerial/professional	23.8	1.00	Reference	36.4	1.00	Reference
Clerical	28.8	1.28	(1.03–1.59)*	37.2	1.02	(0.82–1.27)
Service/sales	20.6	0.87	(0.66–1.16)	28.9	0.71	(0.52–0.97)*
Laborer	23.1	1.03	(0.85–1.24)	30.7	0.77	(0.64–0.93)**
Transportation	34.4	1.52	(1.16–1.98)**	34.4	0.91	(0.72–1.14)
Hypertension						
Managerial/professional	10.5	1.00	Reference	24.4	1.00	Reference
Clerical	15.9	1.66	(1.24–2.21)**	36.3	1.19	(0.95–1.48)
Service/sales	10.7	1.13	(0.77–1.66)	29.3	0.71	(0.59–1.12)
Laborer	13.8	1.55	(1.21–1.99)**	37.5	0.77	(0.99–1.44)
Transportation	17.5	1.66	(1.17–2.36)**	37.2	0.91	(0.93–1.47)
Hyperlipidemia						
Managerial/professional	–	–		36.6	1.00	Reference
Clerical	–	–		37.5	1.04	(0.84–1.30)
Service/sales	–	–		32.2	0.83	(0.61–1.13)
Laborer	–	–		29.8	0.84	(0.61–0.89)*
Transportation	–	–		31.5	0.79	(0.63–0.99)
Hyperglycemia						
Managerial/professional	–	–		8.1	1.00	Reference
Clerical	–	–		10.9	1.52	(1.06–2.17)*
Service/sales	–	–		10.0	1.31	(0.80–2.15)
Laborer	–	–		8.9	1.15	(0.83–1.58)
Transportation	–	–		9.7	1.26	(0.86–1.85)
Metabolic syndrome						
Managerial/professional	–	–		22.9	1.00	Reference
Clerical	–	–		24.4	1.13	(0.88–1.45)
Service/sales	–	–		17.9	0.74	(0.51–1.08)
Laborer	–	–		20.9	0.90	(0.73–1.12)
Transportation	–	–		27.8	1.31	(1.02–1.68)*

OR, odds ratio; CI, confidence interval. Age-adjusted odds ratios, with managerial/professional workers as the reference, were calculated using a multiple logistic regression analysis. Age was put into the model using a dummy variable: <25 yr old (reference), 25–29 yr, 30–34 yr, 35–39 yr, 40–44 yr, 45–49 yr, 50–54 yr and 50–59 yr. * p<0.05, ** p<0.001, *** p<0.001.

Table 5. Age-adjusted odds ratio of behavioral factors and positive findings of physiological data (Women)

Item	18–39 yr			40–59 yr		
Occupational class	%	OR	(95%CI)	%	OR	(95%CI)
Smoking						
Managerial/professional	13.3	1.00	Reference	18.6	1.00	Reference
Clerical	14.9	1.13	(0.81–1.57)	11.2	0.54	(0.36–0.80)**
Service/sales	22.4	2.10	(1.48–2.98)***	28.0	1.86	(1.27–2.73)**
Laborer/transportation	21.8	1.86	(1.31–2.64)**	16.0	0.88	(0.61–1.26)
Obesity						
Managerial/professional	10.6	1.00	Reference	17.9	1.00	Reference
Clerical	7.4	0.67	(0.45–0.99)*	13.6	0.76	(0.51–1.12)
Service/sales	7.6	0.74	(0.47–1.14)	17.1	0.96	(0.63–1.44)
Laborer/transportation	13.3	1.31	(0.88–1.95)	18.7	1.07	(0.74–1.54)
Hypertension						
Managerial/professional	2.7	1.00	Reference	18.6	1.00	Reference
Clerical	2.3	0.79	(0.38–1.65)	14.3	0.83	(0.56–1.22)
Service/sales	0.8	0.39	(0.13–1.14)	18.9	0.92	(0.61–1.38)
Laborer/transportation	3.5	1.29	(0.61–2.75)	22.6	1.21	(0.84–1.73)
Hyperlipidemia						
Managerial/professional	–	–		25.4	1.00	Reference
Clerical	–	–		22.9	1.00	(0.71–1.42)
Service/sales	–	–		26.3	0.95	(0.66–1.38)
Laborer/transportation	–	–		24.0	0.87	(0.62–1.21)
Hyperglycemia						
Managerial/professional	–	–		3.2	1.00	Reference
Clerical	–	–		2.6	0.92	(0.40–2.15)
Service/sales	–	–		3.5	0.97	(0.40–2.31)
Laborer/transportation	–	–		3.2	0.91	(0.41–2.00)
Metabolic syndrome						
Managerial/professional	–	–		3.3	1.00	Reference
Clerical	–	–		3.2	1.15	(0.50–2.61)
Service/sales	–	–		2.7	0.72	(0.29–1.81)
Laborer/transportation	–	–		4.6	1.32	(0.62–2.83)

OR, odds ratio; CI, confidence interval. Age-adjusted odds ratios, with managerial/professional workers as the reference, were calculated using a multiple logistic regression analysis. Age was put into the model using a dummy variable: <25 yr old (reference), 25–29 yr, 30–34 yr, 35–39 yr, 40–44 yr, 45–49 yr, 50–54 yr and 50–59 yr.
* $p<0.05$, ** $p<0.001$, *** $p<0.001$.

Lower socioeconomic status was associated with higher mean blood pressure in almost all previous studies in other developed countries[33], although clear occupational class inequalities in blood pressure or prevalence of hypertension were not shown in the previous studies in Japan. Part of the socioeconomic gradient of blood pressure may be accounted for by the socioeconomic gradient in alcohol consumption, since it is well known that heavy drinking induces hypertension[34]. Although it is known that obesity induces hypertension, the pattern for obesity was different from that of blood pressure in our study. Sobal *et al.*[35] reviewed that although groups of lower socioeconomic status were more at risk of becoming obese across all industrialized nations, the effect was highly consistent among women but less consistent among men. However, we could not find such results. Wardle *et al.*[36] compared the effects on obesity among three socioeconomic indices: income, educational attainment, and occupation. They found that higher educational attainment and higher socioeconomic status were associated with a lower risk for obesity in both men and women, whereas higher occupational status was associated with a lower risk for women but not men. Lower-status occupations are likely to involve more physical activity than higher-status occupations among men, and this could be protective against obesity.

This study revealed the presence of occupational class inequalities in behavioral and biological factors, except for obesity and indices of lipid and glucose metabolism. The inequalities were more prominent among men than women and among the younger age group than the older age group. For married women, the partner's occupational class or household level variables might influence on the results. European studies showed that socio-economic position measured by the own occupation was less strongly related to mortality and cardio vascular risk factors in married women than in men[37, 38]. Furthermore, health inequalities in women appeared to be greater when their socio-economic position was measured by occupations of partner or household income, while the impact of partner's occupational class was not apparent for men[38, 39].

This study also revealed that the most disadvantaged occupational class was transportation workers. It is reported that long working hours and heavy work load are more common in smaller-scale transportation enterprises than larger-scale enterprises, and theses work conditions are likely to associate unfavorable health behaviors[40].

Unfavorable work environment in smaller-scale enterprises may bind the workers of lower occupational social class to unfavorable behaviors, and may cause occupational class inequalities. In general, occupational health activities are less sufficient in smaller-scale enterprises[25, 26]. A higher prevalence of hypertension, obesity, and smoking in male workers in smaller enterprises compared to those in larger organizations was also reported in Japan[27]. Smoking and hypertension are strong risks for stroke and ischemic heart diseases for Japanese[1, 2]. Excessive intake of alcohol is also cardiovascular disease risk[41], although moderate alcohol consumption prevents coronary disease[42, 43]. The inequalities in these risks might cause inequalities in cardiovascular disease mortality and morbidity.

This study has some limitations. First, the response rate of the enterprises for providing the anonymous employee data was low. The response rates by the groups of enterprise-scale, which was presumed by the number of participants of health check-up, were not significantly different. However, enterprises with better attitudes toward occupational safety and health activity may have been more likely to respond, and that may have resulted in underestimation of inequalities among occupational classes. Second, we could not differentiate whether the inequalities were derived from the selection bias of choosing occupations or a result of engaging in the occupation due to the cross-sectional study design. Third, we did not estimate other socioeconomic indicators, such as income and educational attainment. Finally, burdens in addition to those from their own job, such as domestic duties or the husband's socioeconomic status, might modify the effects of occupational classes for women. We could not evaluate such factors. Despite those limitations, the strength of this study is that we used working populations that represent the major working population in Japan, workers in medium- or small-scale enterprises, and we showed significant inequalities in strong risks for cardiovascular diseases such as smoking and hypertension, among occupational social classes in Japan.

In conclusion, this study revealed the presence of occupational class inequalities in behavioral and biological factors, except for obesity and indices of lipid and glucose metabolism. A strategy for health promotion that targets the disadvantaged population is necessary for the prevention of cardiovascular diseases.

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References

1) Iso H (2011) Lifestyle and cardiovascular disease in Japan. J Atheroscler Thromb **18**, 83–8.
2) Ueshima H, Sekikawa A, Miura K,Turin TC, Takashima N, Kita Y, Watanabe M, Kadota A, Okuda N, Kadowaki T, Nakamura Y, Okamura T (2008) Cardiovascular disease and risk factors in Asia: a selected review. Circulation **118**, 2702–9.
3) Ueshima H (2007) Explanation for the Japanese paradox: prevention of increase in coronary heart disease and reduction in stroke. J Atheroscler Thromb **14**, 278–86.
4) Ministry of Health, Labour and Welfare (2008) Patient Survey. http://www.mhlw.go.jp/english/database/db-hss/ps.html. Accessed May 20, 2012.
5) Ministry of Health, Labour and Welfare (2010) Vital Statistics, Trends in leading causes of death. http://www.mhlw.go.jp/english/database/db-hw/populate/dl/03.pdf. Accessed May 20, 2012.
6) Ministry of Health, Labour and Welfare (2008) Guide for health promotion of workers in workplace. http://www.mhlw.go.jp/bunya/roudoukijun/anzeneisei12/pdf/10.pdf. Accessed May 20, 2012.
7) Avendaño M, Kunst AE, Huisman M, van Lenthe F, Bopp M, Borrell C, Valkonen T, Regidor E, Costa G, Donkin A,

Borgan JK, Deboosere P, Gadeyne S, Spadea T, Andersen O, Mackenbach JP (2004) Educational level and stroke mortality: a comparison of 10 European populations during the 1990s. Stroke **35**, 432–7.
8) Cox AM, McKevitt C, Rudd AG, Wolfe CD (2006) Socioeconomic status and stroke. Lancet Neurol **5**, 181–8.
9) Hart CL, Hole DJ, Smith GD (2000) The contribution of risk factors to stroke differentials, by socioeconomic position in adulthood: the Renfrew/Paisley Study. Am J Public Health **90**, 1788–91.
10) Kerr GD, Slavin H, Clark D, Coupar F, Langhorne P, Stott DJ (2011) Do vascular risk factors explain the association between socioeconomic status and stroke incidence: a meta-analysis. Cerebrovasc Dis **31**, 57–63.
11) Kunst AE, Groenhof F, Mackenbach JP, Health EW (1998) Occupational class and cause specific mortality in middle aged men in 11 European countries: comparison of population based studies. EU Working Group on Socioeconomic Inequalities in Health. BMJ **316**, 1636–42.
12) Lahelma E, Martikainen P, Laaksonen M, Aittomaki A (2004) Pathways between socioeconomic determinants of health. J Epidemiol Community Health **58**, 327–32.
13) McFadden E, Luben R, Wareham N, Bingham S, Khaw KT (2008) Occupational social class, educational level, smoking and body mass index, and cause-specific mortality in men and women: a prospective study in the European Prospective Investigation of Cancer and Nutrition in Norfolk (EPIC-Norfolk) cohort. Eur J Epidemiol **23**, 511–22.
14) Pekkanen J, Tuomilehto J, Uutela A, Vartiainen E, Nissinen A (1995) Social class, health behaviour, and mortality among men and women in eastern Finland. BMJ **311**, 589–93.
15) Pensola TH, Martikainen P (2003) Cumulative social class and mortality from various causes of adult men. J Epidemiol Community Health **57**, 745–51.
16) Suadicani P, Hein HO, Gyntelberg F (1997) Strong mediators of social inequalities in risk of ischaemic heart disease: a six-year follow-up in the Copenhagen Male Study. Int J Epidemiol **26**, 516–22.
17) Stringhini S, Sabia S, Shipley M, Brunner E, Nabi H, Kivimaki M, Singh-Manoux A (2010) Association of socioeconomic position with health behaviors and mortality. JAMA **303**, 1159–66.
18) Kagamimori S, Gaina A, Nasermoaddeli A (2009) Socioeconomic status and health in the Japanese population. Soc Sci Med **68**, 2152–60.
19) Wilkinson RG (1992) National mortality rates: the impact of inequality? Am J Public Health **82**, 1082–4.
20) Marmot MG, Smith GD (1989) Why are the Japanese living longer? BMJ **299**, 1547–51.
21) Li Q, Morikawa Y, Sakurai M, Nakamura K, Miura K, Ishizaki M, Kido T, Naruse Y, Suwazono Y, Nakagawa H (2010) Occupational class and incidence rates of cardiovascular events in middle aged men in Japan. Ind Health **48**, 324–30.
22) Fukuda Y, Nakamura K, Takano T (2005) Accumulation of health risk behaviours is associated with lower socioeconomic status and women's urban residence: a multilevel analysis in Japan. BMC Public Health **5**, 53.
23) Martikainen P, Ishizaki M, Marmot MG, Nakagawa H, Kagamimori S (2001) Socioeconomic differences in behavioural and biological risk factors: a comparison of a Japanese and an English cohort of employed men. Int J Epidemiol **30**, 833–8.
24) Statistics Bureau, Japan Ministry of Internal Affairs and Communications (2006) Establisment and Enterprise Census. http://www.e-stat.go.jp/SG1/estat/ListE.do?bid=000001008300&cycode=0. Accessed January 11, 2012.
25) Fukuda Y, Nakamura K, Takano T, Nakao H, Imai H (2007) Socioeconomic status and cancer screening in Japanese males: Large inequality in middle-aged and urban residents. Environ Health Prev Med **12**, 90–6.
26) Furuki K, Hirata M, Kage A (2006) Nationwide survey of occupational health activities in small-scale enterprises in Japan. Ind Health **44**, 150–4.
27) Hoshuyama T, Hino Y, Kayashima K, Morita T, Goto H, Minami M, Sakuragi S, Tanaka C, Takahashi K (2007) Inequality in the health status of workers in small-scale enterprises. Occup Med (Lond) **57**, 126–30.
28) Statistic Bureau, Japan Ministry of Internal Affairs and Communications. Japan (2009) Standard Occupational Classification (Rev. 5th, December 2009). http://www.stat.go.jp/english/index/seido/shokgyou/co09-4.htm. Accessed January 11, 2012.
29) Committee to Evaluate Diagnostic Standards for Metabolic Syndrome (2005) Definition and the diagnostic standard for metabolic syndrome. J Jpn Soc Int Med **94**, 794–809.
30) Ministry of Health Labour and Welfare (2009) National Health and Nutrition Survey 2008. http://www.mhlw.go.jp/houdou/2009/11/dl/h1109-1b.pdf. Accessed July 23, 2012.
31) Schaap MM, Kunst AE (2009) Monitoring of socio-economic inequalities in smoking: learning from the experiences of recent scientific studies. Public Health **123**, 103–9.
32) Laaksonen M, Rahkonen O, Karvonen S, Lahelma E (2005) Socioeconomic status and smoking: analysing inequalities with multiple indicators. Eur J Public Health **15**, 262–9.
33) Colhoun HM, Hemingway H, Poulter NR (1998) Socio-economic status and blood pressure: an overview analysis. J Hum Hypertens **12**, 91–110.
34) Nakamura K, Okamura T, Hayakawa T, Hozawa A, Kadowaki T, Murakami Y, Kita Y, Okayama A, Ueshima H (2007) The proportion of individuals with alcohol-induced hypertension among total hypertensives in a general Japanese population: NIPPON DATA90. Hypertens Res **30**, 663–8.
35) Sobal J, Stunkard AJ (1989) Socioeconomic status and obesity: a review of the literature. Psychol Bull **105**,

260–75.

36) Wardle J, Waller J, Jarvis MJ (2002) Sex differences in the association of socioeconomic status with obesity. Am J Public Health **92**, 1299–304.

37) Koskinen S, Martelin T (1994) Why are socioeconomic mortality differences smaller among women than among men? Soc Sci Med **38**, 1385–96.

38) Bartley M, Martikainen P, Shipley M, Marmot M (2004) Gender differences in the relationship of partner's social class to behavioural risk factors and social support in the Whitehall II study. Soc Sci Med **59**, 1925–36.

39) Krieger N, Chen JT, Selby JV (1999) Comparing individual-based and household-based measures of social class to assess class inequalities in women's health: a methodological study of 684 US women. J Epidemiol Community Health **53**, 612–23.

40) Oyama H, Suzuki K, Sakai K (2011) Research on the working conditions, fatigue, and sleep of truck drivers: the problems of small and medium-sized transport enterprises analysed by using a questionnaire survey. J Sci Labour **87**, 41–56.

41) Rehm J, Baliunas D, Borges GL, Graham K, Irving H, Kehoe T, Parry CD, Patra J, Popova S, Poznyak V, Roerecke M, Room R, Samokahvalov AV, Taylor B (2010) The relation between different dimensions of alcohol consumption and burden of disease: an overview. Addiction **105**, 817–43.

42) Murray RP, Connett JE, Tyas SL, Bond R, Ekuma O, Silversides CK, Barnes GE (2002) Alcohol volume, drinking pattern, and cardiovascular disease morbidity and mortality: is there a U-shaped function? Am J Epidemiol **155**, 242–8.

43) Rimm EB, Williams P, Fosher K, Criqui M, Stampfer MJ (1999) Moderate alcohol intake and lower risk of coronary heart disease: meta-analysis of effects on lipids and homeostatic factors. BMJ **319**, 1523–8.