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Analysis of Factors Associated with the Workers' Health Status Using Periodic Health Examination Data by Size of Enterprises

Jong Uk Won[1], Jaesuk Song[1], Yeon Soon Ahn[2], Jaehoon Roh[1], and Chung Yill Park[3]

[1]Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, Korea;
[2]Korea Occupational Safety & Health Agency, [3]Department of Preventive Medicine, Catholic University College of Medicine, Seoul, Korea.

This study was conducted to determine whether the size of an enterprise can make a difference to workers' health and to examine those factors, which influence workers' health. The subjects of this study included 26,324 workers employed in manufacturing industry who received medical examinations at the Industrial Health Center at Yonsei University in 1995, 1996 and 1997. Medical examination data were used as a measure of health. Each enterprise was classified by size into three categories: Small scale enterprises (SSE) that employ no more than 50 regular employees; middle scale enterprise (MSE) that employ from 50 to 300 regular employees; and large scale enterprise (LSE) that employ more than 300 regular employees. Health conditions, according to the size of the enterprise, were determined by comparing prevalence rates, and direct standardization methods were used based upon the Korean population, as a standard population, in order to adjust for differences in population structure.

1. The findings of the medical examinations showed that, the prevalence rate in SSEs was higher than in MSEs or LSEs, but that this relationship was reversed after standardizing for sex and age.

2. Logistic regression analysis showed that, although subjects of advanced age, prolonged work history, and male gender had higher risks of disease, the size of the enterprise had no significant effect upon these risks.

Key Words: Small scale enterprise, workers' health status, size of enterprise

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Reprint address: requests to Dr. Jong Uk Won, Department of Preventive Medicine, Yonsei University College of Medicine, C.P.O. Box 8044, Seoul 120-752, Korea. Tel: 82-2-361-5343, Fax: 82-2-392-8622, E-mail: juwon@yumc.yonsei.ac.kr

INTRODUCTION

Many factors can influence a worker's health, such as his working environments, working conditions, hazardous agents, working hours, and wages, and these may be closely related to the size of the enterprise. The survey of the Ministry of Labor showed that the conditions in Korea for workers in small-scale enterprises (SSE) are worse than conditions in large-scale enterprises (LSE), in particular wages are low and working conditions bad.[1-4] The definition of SSE differs from country to country. Generally, however, SSE is defined as an enterprise that employs less than 50 persons.[5] In 1996, the number of SSEs in Korea was 183,023 (87.1%); while the number of LSEs with more than 300 regular employees was 3,210 (1.5%). Whereas 2.47 million workers (30.3%) were employed in SSEs, 2.61 million workers (32%) worked in middle scale enterprises (MSEs) that employ from 50 to 300 regular employees and 3.07 million workers (37.7%) were employed by LSEs.[4]

Compared with LSEs, SSEs are deficient in groups that provide occupational health services to their workers, and have many inappropriate ideas about concepts of occupational health (because most workers are uneducated), and little interest in occupational health.[6-10] Further, they are known to have poor working environments, a high incidence of occupational disease and industrial accidents.[11-13]

In Korea, the accident rate in SSEs was 1.59 (persons per one hundred), while that of MSEs was 0.69, and of LSEs 0.46. That is, the accident

rate in SSEs was 3.5 times higher than that of LSEs.[3]

However, the incidence rate of occupational disease in 1996 was 1.45 (workers per 10,000) in SSEs, while that in LSEs was 2.73, which shows that the rate in SSEs was rather low. In 1995, the incidence in SSEs was 1.07 (workers per 10,000), while that in enterprises with more than 500 employees was 1.72, which also shows that the rate was low in SSEs,[3] and that the gap became greater in 1996. The incidence of probable occupational disease is unknown because no countrywide statistics are available, but according to the assessment results of health care in small enterprises supported by the government in 1995, there was no gap between total enterprises and small enterprises in terms of the amount of probable occupational disease and general diseases.

According to the study of Won et al.[14] which compared workers in SSEs with workers in LSEs, those in SSEs not only have more liver diseases, hepatitis B, and pneumoconiosis, but they are also more likely to have probable occupational diseases and other general diseases. However, when sex and age were adjusted by logistic regression analysis, there were no significant differences.

This study was performed to determine workers' health conditions and to identify the effects of different factors, which can influence workers' health placing particular emphasis upon the size of the enterprise. We used data from medical examinations accumulated over a three years period in order to reduce the number of workers who did not take the medical examinations to determine in detail the health of workers in manufacturing industry.

MATERIALS AND METHODS

Subjects

The study subjects consisted of 26,324 workers employed in manufacturing industry who had undergone medical examinations conducted by one occupational service institute in Incheon, Korea, during 1995 - 97. The enterprises were classified, according to size, into three categories: enterprises with no more than 50 regular employees were designated as SSEs, as defined by the International Industrial Health Seminar;[5] enterprises employing 50 to 300 regular employees were designated as MSEs, as defined by the Occupational Health Management Agency designated by the 19th article of the Enforcement Ordinance of Industrial Safety and Health Law, and enterprises with more than 300 regular employees were designated as LSEs.

Health examination and diagnostic criteria

Special health examinations were performed for specific hazardous agents and general health, according to the guidelines of the Administration of Labor. Screening and confirmatory examination was undertaken for specific hazardous agents. The general health examination included, the screening and confirmatory examination for hypertension, hypercholesterolemia, diabetes mellitus, liver disease, renal disease, anemia and so on. The diagnostic criteria shown in Table 1 were obtained

Table 1. Diagnostic Criteria and Some Abbreviations

Disease/Abbreviations	Diagnostic criteria/
Hypertension	Systolic BP > 160 or Diastolic BP > 100
Diabetes Mellitus	Blood sugar AC > 140 mg/dl, PC > 200 mg/dl
Hypercholesterolemia	Total cholesterol > 260
Liver disease	SGOT > 50IU, SGPT > 45, GGT > 100
Anemia	Male; Hemoglobin < 12.0 g/dl, Female; Hemoglobin < 10.5 g/dl
Tuberculosis	Active lesion in chest X-ray
Viral hepatitis B	Liver disease with HbsAg(+)
Noise induced hearing loss	Average hearing of 500Hz, 1000Hz and 2000Hz > 30dB and hearing of 4000Hz > 50dB
Pneumoconiosis	ILO classification of pneumoconiosis

in accordance with the guidelines of Administration of Labor and National Health Insurance Corporation.

Workers diagnosed with probable occupational disease or one of the other general diseases in the health examination over a three-years period or had known diseases, were classified as having disease.

Method of analysis

In order to determine whether the size of the enterprise had an impact on workers' health, health examination data were analyzed. In order to reduce bias resulting from the population structure of differently sized enterprises, the total study population was regarded as a standard population, and the prevalence rates in health examination were standardized by age and sex. Logistic regression analysis was conducted, using the results of medical examinations as a dependent variable. Statistical analysis was conducted using SAS version 6.12.[15]

RESULTS

General characteristics

The numbers of subjects studied in SSEs, MSEs, and LSEs were 7,231, 9,857, and 9,236, respectively. Workers in their 50s and 60s were more numerous in SSEs. As for the percentage of male workers, SSEs had 80.9%, MSEs had 71.8%, and LSEs had 68.3%. When the size of the enterprise was large enough, the number of male workers had statistical significance ($p < 0.01$). As for the average work history, that for LSEs was 9.2 years, and that for SSEs was 4.9 years. When the size of the enterprise was large enough, work history was longer ($p < 0.01$) (Table 2).

Distribution of diseases in different size enterprises

As for the total prevalence rate of workers who were diagnosed with probable occupational diseases or other general diseases was as follows, SSEs had 17.8%, MSEs 15.7%, and LSEs 16.5%—and the prevalence in SSEs was significantly higher ($p < 0.01$). As for the ratio of male workers among those who had diseases, the ratio was 85.7% in SSEs, and 76.6% in LSEs—and this ratio of male workers was higher in SSEs ($p < 0.01$). As for specific diseases, hypertension, hypercholesterolemia, tuberculosis, and diabetes showed no differences according to the size of enterprise, but the incidence of liver disease was higher in LSEs; anemia was higher in MSEs; and hepatitis B was highest in SSEs. As for the probable occupational

Table 2. Study Subject Enterprises and Population Structure of the Workers by Sex and Age

		SSE	MSE	LSE	*p*-value
No. of enterprise		588	191	36	
Work duration (years)*		4.9 ± 3.9	6.8 ± 5.0	9.2 ± 6.0	0.0001
Sex	Male	5,850(80.9)	7,075(71.8)	6,306(68.3)	0.001
	Female	1,381(19.1)	2,782(28.2)	2,930(31.7)	
Age groups (years)	Less than 20	160(2.2)	141(1.4)	235(2.3)	0.001
	20 - 29	1,260(17.4)	2,432(24.7)	2,032(22.0)	
	30 - 39	2,091(28.9)	2,898(29.4)	2,590(28.0)	
	40 - 49	2.017(27.9)	2,784(28.2)	2,986(32.3)	
	50 - 59	1,346(18.6)	1,450(14.7)	1,366(14.8)	
	more than 60	357(3.0)	152(1.5)	27(0.3)	
Total		7,231(100.0)	9,857(100.0)	9,236(100.0)	

SSE, Small Scale Enterprise; MSE, Middle Scale Enterprise; LSE, Large Scale Enterprise.
unit, person(%); *mean±SD.

diseases, the number of workers with pneumoconiosis and noise induced hearing loss was significantly higher in SSEs ($p < 0.01$) (Table 3). The high prevalence of pneumoconiosis in SSEs was attributed to foundry work.

Prevalence rate of disease in different size enterprises standardized by standard population

The three study groups had different ages and male female ratios. In order to determine the differences in the prevalence rates in the three groups, the prevalence rates were adjusted by standardizing for sex and age using the Korean population as a standard population. As for the disease prevalence rates before adjusting for sex and age, SSEs had 17.8%, MSEs 15.7%, and LSEs 16.5%, and the prevalence rate in SSEs was significantly higher than that in LSEs. However, the prevalence rate measured after adjusting for sex and age was respectively, 15.8%, 16.6%, and 16.8%, and the prevalence rate in SSEs was lower ($p < 0.01$) (Table 4).

Logistic regression analysis of factors that influence the results of medical examination

To further explore the relationship between enterprise size and workers' health, multiple logistic regression analysis was performed. Dependent variable was the existence of worker disease and independent variables were age, sex, duration of work, and enterprise size. Table 5 shows the results of the analysis. When other variables were controlled for, advanced age, male gender, and extended work history increased the risk of disease. However, the size of the enterprise had no influence on the presence of disease.

Table 3. Age and Sex Distribution of Workers with Diseases and Prevalence Rate of Specific Disease by Enterprise Size

	SSE	MSE	LSE	Total	*p*-value
Age(yr)*	46.7 ± 10.5	43.4 ± 10.1	42.7 ± 9.2	44.1 ± 10.1	
Sex male	1,100 (85.7)	1,185 (76.6)	1,166 (76.7)	3,451 (79,2)	0.001
Female	184 (14.3)	363 (23.2)	357 (23.5)	904 (20.8)	
Workers with specific disease					
Hypertension	228 (3.2)	286 (2.9)	257 (2.8)	771 (2.9)	0.368
High cholesterolemia	143 (2.0)	199 (2.0)	226 (2.5)	568 (2.2)	0.059
Liver disease	421 (5.8)	517 (5.3)	576 (6.2)	1,514 (5.8)	0.013
Tuberculosis	34 (0.5)	40 (0.4)	38 (0.4)	112 (0.4)	0.789
Diabetes mellitus	96 (1.3)	117 (1.2)	112 (1.2)	325 (1.2)	0.693
Hepatitis B	138 (1.9)	131 (1.3)	150 (1.6)	419 (1.6)	0.011
Anemia	50 (0.7)	117 (1.7)	101 (1.1)	268 (1.0)	0.004
Pneumoconiosis	32 (0.44)	6 (0.06)	1 (0.01)	39 (0.1)	0.001
Noise induced hearing loss	98 (1.4)	95 (1.0)	83 (0.9)	276 (1.0)	0.01
Other disease	299 (4.1)	313 (3.1)	258 (2.8)	870 (3.3)	0.001
Total workers with any disease	1,284 (17.8)	1,548 (15.7)	1,523 (16.5)	4,355 (16.5)	0.002
Total No. of workers	7,231 (100)	9,857 (100)	9,236 (100)	26,324 (100)	

unit, person(%); *mean±SD; No, number.

Table 4. Comparison of Crude Prevalence Rate and Sex and Age Adjusted Prevalence Rate by Size of Enterprise

	SSE	MSE	LSE	*p*-value
Crude prevalence rate*	17.8	15.7	16.5	0.002
Sex and age adjusted prevalence rate*	15.8	16.6	16.8	0.002

*percent.

DISCUSSION

In comparing the size of an enterprise, the initial prevalence rate in SSEs was found to be 17.8%, and this was significantly higher than the 15.7% or 16.5% in LSEs. However the percentages of male and elderly subjects in SSEs was higher than those of MSEs or LSEs. This means that there are differences in population structure. Therefore, the difference in prevalence rates might be resulted from such differences in population structure.

In the present study, the prevalence rate was standardized by sex and age in order to adjust for difference in prevalence rates caused by such differences in the population structure. First, the Korean population was chosen as the standard population and age specific prevalence rate by sex was calculated after taking into account the standard population data. The prevalence rate of disease in the study population before standardization showed was highest in SSEs, but after standardization LSE's showed the highest value, and this difference was statistically significant. Such findings were probably the result of the characteristics of the population structure, and was the result of the tendency of SSEs to employ older male workers. Meanwhile, prevalence rates standardized by age and by sex were lowest in SSEs and highest in LSEs. Logistic regression analysis showed that workers' disease was influenced by sex, age and duration of work, but not influenced by the size of the enterprise after controlling for age and sex. After controlling for the population structure, the findings that the prevalence rate in LSEs was higher than in SSEs or MSEs greatly differed from the general view. There is some possibility that population structure might have been biased. In terms of the recruiting process, a study by Han et al.[16] showed that 30.4% of SSEs conduct pre-employment medical examinations at the time of recruitment, MSEs conducted 73.3%, and LSEs conducted 89.4%, i.e., the larger the size of the enterprise, the higher the rate of pre-employment medical examinations at recruitment, more significantly such examinations are used as a means of eliminating disqualified or unhealthy individuals.[16-17] In other words, LSEs do not employ unhealthy workers as a result of medical examination at recruitment, while SSEs employed more unhealthy workers because they tend not to conduct medical examination at recruitment. Furthermore, the fact that the average age in SSEs was higher than in MSEs or LSEs while the duration or work was shorter was likely to result from the higher unemployment rate of workers in SSEs.[18-19] In addition, the population structure in this study suggests that workers who retire from MSEs or LSEs may be reemployed by SSEs.

Another possibility why the rate of signs of disease may be higher in LSEs is that unhealthy workers may more easily avoid medical examinations in SSEs, because they fear dismissal. In other words, because LSEs have stable employment systems and a labor union or labor relations commission, it is relatively difficult for workers to be dismissed according to the results of a medical examination. However, the total number of workers in SSEs is difficult to determine because the rate of occupational turnover is high and employers often understate the number of workers to reduce tax. These above issues warrant further study.

Although the prevalence rate standardized by population structure was the highest in LSE, the prevalence of worker disease was not found to be influenced by the size of an enterprise (Table 5). It was only influenced by age, sex and work duration. Generally, workers in SSEs are believed to experience more disease due to the working conditions, but this general viewpoint may be mistaken according to the above results. The higher prevalence rates in SSEs are due, at least in part, to differences in the population structure and our study shows that workers' disease status is not influenced by the size of enterprise in a straightforward manner.

In the present study, the kinds of enterprises were not controlled, and were limited to the Kyung-in area. The subjects included only those workers who had received service from one of the occupational health service organizations. Consequently, selection bias could have occurred. However, despite the shortcomings of the present study, studies like it on the characteristics of workers' health as related to the size of enterprise must continue to be undertaken. The results of the

Table 5. Logistic Regression Analysis of Health Status by Health Examination on the General Variables

	Regression coefficient	Standard error of coefficient	Odds ratio	95% confidence interval
Age(years)	0.0581	0.0019	1.06	1.056 - 1.064
Sex[1] female	-0.584	0.0425	0.564	0.519 - 0.612
Size[2] MSE	0.0191	0.0448	1.028	0.942 - 1.122
LSE	0.0415	0.0487	1.034	0.940 - 1.138
Work duration(years)	0.0151	0.0034	1.017	1.010 - 1.024
-2log L 22034.6, x2 = 1582.0, p=0.0001				

[1]reference is male=1, [2]reference is SSE=1.

workers' medical examination shows that, compared with the 5.51% rate for the whole country, the overall rate of disease was much higher because it was accumulated over three years,[3] moreover, different institutes use different diagnostic criteria. Generally, in the presentthe diagnostic criteria were applied more strictly, and therefore, the prevalences quoted are lower than those that would have been obtained had the guidelines of the Administration of Labor and National Health Insurance Corporation been applied.

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