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Occupational Injuries in Korea: A Comparison of Blue-Collar and White-Collar workers' Rates and Underreporting

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Abstract: Occupational Injuries in Korea: A Comparison of Blue-Collar and White-Collar workers' Rates and Underreporting: Jonguk WON, *et al.* Yonsei University College of Medicine, Institute for Occupational Health, Korea—This study was performed to determine the differences in occupational injuries and illnesses between white-collar and blue-collar workers and to estimate the magnitude of the underreporting of these injuries and illnesses in Korea. Two datasets were used. One was a cohort established in the Gyeongin area with workers who underwent mandated health examinations, and the other was the National Health Insurance (NHI) data of claims submitted by workers employed between 1999 and 2001. Workers were classified into two groups—white-collar and blue-collar workers—according to their job types and the type of health examination they received. Injury rates were calculated for white-collar and blue-collar workers. The differences in the incidences of musculoskeletal diseases or injury and poisoning between the two groups were regarded as unreported occupational injuries or illnesses. Thereafter, work-related injury rates were estimated. With regard to medical treatment for musculoskeletal diseases or injuries and poisonings covered by the NHI, blue-collar workers had 3.47 more cases per 100 person-years than white-collar workers. This translates into a rate of between 12.57 and 18.1 injured workers per million working hours. The injury rate was 2.74 to 3.29 injured workers and the incidence rate was 3.62 to 5.44 injuries and illnesses per hundred workers. The estimated occupational injury and illness rates in this study were likely to be two to three times higher than those officially reported. However, the limitations of the study should also be considered.
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Statistics of occupational injury are critical in establishing occupational health policy, therefore every nation strives to ensure that statistical input is accurate.

OECD nations, including Korea, have used workers' compensation claims data to produce statistics on occupational injuries and illnesses. However, minor injuries and illnesses go unreported, and there are some industries not insured under the workers' compensation insurance. As a consequence, there has been a discrepancy between reported and actual incidence rates.

To make up for this discrepancy, England and Germany implemented a complementary system in which all work related injuries and illnesses have to be reported to the labor inspectorates. However, only 50% of occupational injuries or illness in Germany have been reported to the labor inspectorates[1)]. The Ministry of Health, Labour and Welfare of Japan surveys workplaces, that regularly employ 100 or more workers, once every 6 months, and annually surveys workplaces that employ 10 to 99 workers[2)].

The United States of America conducts the Census of Fatal Occupational Injuries (CFOI) to obtain data on fatal work injuries and illnesses, and also conducts a survey of Occupational Injuries and Illnesses (SOII) to include non-fatal work injuries and illnesses[3)]. Although the survey method is useful for obtaining first-hand data, the quality of the survey is dependent on the sample size and the respondents' answers.

Azaroff *et al.* cited the Bureau of Labor Statistics survey, workers' compensation, medical records and physician reporting system as possible channels for reporting workplace injuries and illness, and added that underreporting can occur[4)]. Pransky *et al.* pointed out that less than 5% of workers reported work-related injuries to their supervisor[5)]. Weddle reported that 39%

of injured workers reported their work injuries to their supervisor[6], and Shannon and Lowe also reported in their study of 2,500 Canadian workers that 57 out of 143 injured workers did not apply for sick leave that they were entitled to[7].

In Korea, occupational injuries and illnesses that need at least four days of treatment are eligible for insurance benefits under the Industrial Accident Compensation Insurance (IACI) scheme[8]. Nationwide statistics on occupational injuries and illnesses have been established based on IACI claims. However, in a unofficial survey of 797 labor unions, 24.2% of total respondents stated that their companies did not properly report work-related injuries and illnesses. Furthermore, 15% of the respondents stated that their workplace injuries were treated under National Health Insurance (NHI), instead of IACI[9].

The occupational injury frequency rate of Korea was 3.13 injured workers per one million working hours, which was 1.7 times higher than that of 1.79 for Japan for all industries. The severity rate expressed by the lost working days per one thousand working hours in Korea was 2.12, which was 16.3 times higher than that of 0.13 for Japan for all industries[2, 10]. The incidence rate with lost work days, number of injuries and illnesses per 100 full-time workers, was 1.7 per 100 full-time workers in the US, whereas the injury rate in Korea was 0.77 injured workers per 100 full-time workers in Korea[10, 11]. However, the work-related mortality rate was 0.43 per 10,000 workers in the US, which was 6 times lower than that of 2.6 for Korea[10, 12]. Therefore, the work-related mortality rate was 2.8 times higher in Korea than in the US after adjusting for industry types and working hours[13]. Relatively lower incidence rates but higher mortality rates in Korea, compared to Japan and the US, may suggest either inaccuracy in the Korean statistical information of occupational injuries and illnesses, or that occupational injuries in Korea are more severe, while rarer.

In Korea, NHI data can be a good source of information as far as work related injuries and illnesses are concerned, because many workers seek treatment through the NHI plan when they cannot apply for IACI. NHI data alone are not useful, because of the lack of information on the cause of injuries or illnesses, occupation and industries. However, when information on a NHI claim is combined with patient information, it becomes the best single source of information on occupational injuries and illnesses which are not reported to the IAIC. Consequently, this study used a workers' health examination cohort in a Korean district and their NHI claims data, to delineate the differences between white-collar and blue-collar workers in occupational injuries and illnesses, and also to estimate the magnitude of work-related injuries and illnesses that were not subject to IACI claims, resulting in their exclusion from official statistics of occupational injuries and illnesses.

Methods

Study subjects

Study subjects came from 108,520 people who underwent health examinations in an occupational health service center located in the Gyeongin area, Korea. Among them, 12,224 persons were excluded, because they were government employees, teachers or not working persons. Government employees or teachers are not covered by the IACI; thus their data was not covered in this study. Another 7,043 workers were also excluded, because there was no industrial or occupational information for them. Workers who were under 15 or over 64 yr old (2,135 workers) were also excluded. The remaining 87,078 workers were divided into two groups according to their job title: white-collar workers and blue-collar workers. White collar workers (1,079) who took the specific health examination or blue-collar workers (24,000) who took the general health examination were excluded. The remaining 61,999 workers were included in this study (Table 1).

Research methods

1) Classification of white-collar and blue-collar workers

This study was initiated by the assumption that blue-collar workers have more work related injuries and illnesses than white-collar workers. Thus, the stratification of this analysis by blue-collar/white-collar work was important.

There are two types of health examination in Korea: the general health examination and the specific health

Table 1. Classification of study subjects by job title and type of health examination

Job title	Type of health examination		Total
	General health exam.	Specific health exam.	
White-collar	13,684*	1,079#	14,763
Blue-collar	24,000#	48,315*	72,315
Total	37,684	49,394	87,078

*, cases included; #, cases excluded.

examination. Workers exposed to specific health hazards, such as solvents, chemicals, heavy metals, noise or other physical or hazards, have to take the specific health examination every year, whereas workers not exposed to any specific health hazards have to take the general health examination.

Workers were defined as white-collar workers by the following 14 job titles: administration, management, accounting, business, planning, personnel affairs, human resources, marketing, distribution, inspection, customer service, sales, supporting and international sales. Any worker who took the specific health examination was excluded because the specific health examination is only for blue-collar workers[14].

Blue-collar workers were defined as those with other than a white-collar job title and those who took the specific health examination. Any blue-collar workers who received the general health examination were excluded for a clear-cut classification (Table 1).

2) National Health Insurance claims data

NHI claims data during the period between 1999 and 2001 were analyzed. Although there were primary diagnosis and associate diagnosis as disease codes in the claims data, only primary diagnosis was used for the analysis. The unit of analysis was the number of visits to hospitals. Hospital visits made by the same person because of the same diagnosis were regarded as a single visit. If a worker visited hospital ten times with two different diagnoses, his or her visits were calculated as two visits. The same disease is defined as a disease that is nearly identical up to the three-digit level of the 4th revised Korean Standard Classification of Disease which is the same as the International Classification of Diseases, Tenth Edition (ICD-10)[15].

Study subjects made 554,863 visits during the study period, and 517,327 visits were eligible for this study after invalid cases were excluded. A total of 244,184 cases were analyzed for this study after treating total number of hospital visits made by the same person as a single visit due to the same diagnosis.

Analytical methods

1) Hospital visit rates under the NHI

Average hospital visit rates were calculated as the number of hospital visits per 100 person-years by white-collar and blue-collar workers. The hospital visit rates for musculoskeletal diseases (M code) and injuries and poisonings (S and T code) were separately calculated to compare the incidence of injuries and illnesses between white- and blue-collar workers.

2) Statistical analysis

Chi-square tests were performed to compare the age and sex structure in white collar and blue collar workers. Also multivariate logistic regression analyses were conducted to evaluate the factors influencing the probability of hospital visits. The response variable was whether or not a worker went to a hospital, and the predictor variables included white-collar/blue-collar status, age, sex, and company size. In the second logistic regression, the dependent variable was whether diagnoses of hospital visits were musculoskeletal diseases (M code in ICD-10) or injuries and poisonings (S, T code in ICD-10), and the independent variables were the same as in the first logistic regression. SAS 9.01 version was used for the statistical analyses[16].

3) Estimation of work-related injuries and illnesses

If injuries and illnesses were not related to their work, the hospital visit rates of blue-collar workers and white-collar workers would be expected to be same between blue-collar workers and white collar workers. Therefore, the basic assumption of this study was that higher hospital visit rates of blue-collar workers are related to their work. All rates were calculated by subtracting the rates of blue-collar workers from those of white-collar workers, and the estimated rates of work-related injuries and illnesses were calculated by adding the official rate and the rate of this study, because the two rates are mutually exclusive since the official rate is obtained only from IACI data. Since there no incidence rate has been officially published in Korea, we calculated the ratio of official injury rate over estimated injury rate, and applied it to the incidence rates obtained from NHI. Then, we calculated the incidence rate from IACI. To compare with official statistics, only hospital visits of more than 4 days were used for this estimation[8].

The three rates were calculated as follows[2, 3, 10];

The frequency rate was defined as the number of injured workers per one million working hours:

$$\frac{\text{Number of workers injured by industrial accidents}}{\text{Total working hours*}} \times 1{,}000{,}000$$

(* Working hours from the average working hours of a year in manufacturing industry, Korea)[10]

The injury rate was defined as the number of injured workers per one hundred workers:

$$\frac{\text{Number of workers injured by industrial accidents}}{\text{Total number of workers}} \times 100$$

The incidence rate was defined as the number of work-related injuries and illnesses per 100 workers;

Table 2. General characteristics of study subjects

		White-collar workers (%)	Blue-collar workers (%)	Total	Note
Age***	< 20	258 (1.9)	1,878 (3.9)	2,136	
	20–29	4,518 (33.0)	11,291 (23.4)	15,809	
	30–39	4,794 (35.0)	13,831 (28.6)	18,625	
	40–49	2,479 (18.1)	13,085 (27.1)	15,564	
	50–59	1,279 (9.3)	7,137 (14.8)	8,416	
	60–	356 (2.6)	1,093 (2.3)	1,449	
Gender***					
	Male	9,879 (72.2)	37,000 (76.6)	46,879	
	Female	3,805 (27.8)	11,315 (23.4)	15,120	
Persons by Company size***					No. of Company
	< 50	5,761 (42.1)	18,052 (37.4)	23,813	2,159 (83.4)
	50–299	6,557 (47.9)	20,638 (42.7)	27,195	388 (15.0)
	300 –	1,366 (10.0)	9,625 (19.9)	10,991	43 (1.7)
Total#		13,684 (100.0)	48,315 (100.0)	61,999	2,590 (100.0)
Persons by year					
	1999	13,651 (33.4)	48,168 (33.4)	61,819	
	2000	13,614 (33.4)	48,100 (33.3)	61,714	
	2001	13,555 (33.2)	47,985 (33.3)	61,540	
Total person-year		40,820 (100.0)	144,253 (100.0)	185,073	

***p<0.001. #; total number of persons included during study period from 1999 to 2001.

$$\frac{\text{Number of injuries and illnesses}}{\text{Total number of workers}} \times 100$$

Results

Demographic characteristics of subjects

Of the 61,999 cohort members included in this study, 13,684 members (22.1%) were white-collar workers and 48,315 members (77.9%) were blue-collar workers (Table 2). The total observation period was 185,073 person-years accumulated by workers at 2,590 enterprises. Of all the subjects, 23,813 (38.4%) worked at 2,159 small-sized enterprises employing less than 50 employees.

The age distribution of women workers varied by the type of job and the size of enterprise. Women in the 20–29 yr age group made up 70% of white-collar workers, while women in their 40s and 50s accounted for 56% of blue-collar workers. While 43% of white-collar women and 27% of blue-collar women worked at small companies, 11.4% of white-collar women and 25.6% of blue-collar women worked at large companies (Not shown in Table).

Hospital visit rates by types of disease and job

A total of 244,184 hospital visits were made during 185,073 person-years of observation. The overall hospital visit rate of white-collar workers was 119.43 per 100 person-years while that of blue-collar workers was 135.48 per 100 person-years. Of total hospital visits of at least 4 days (70,727 visits), the hospital visit rate of white-collar workers was 33.71 per 100 person-years and that of blue-collar workers was 39.49 per 100 person-years (Table 3).

According to the ICD-10 categories, both types of workers showed similar hospital visit rates. However, the hospital visit rates of blue-collar workers for injuries and poisonings or musculoskeletal diseases were higher than those of white-collar workers (5.75 and 3.70, respectively).

Hospital visit rates by age, sex and size of enterprise

Overall, white-collar workers needed medical care less often than blue-collar workers, however, it was not consistent through all age groups. In all age groups except the 60s age group, more blue-collar workers consistently had more medical care than white-collar workers, because of musculoskeletal diseases or injuries and poisonings.

A larger number of blue-collar workers in both genders visited hospitals. In terms of the size of business establishment, there was no difference in the hospital visit rates for the treatment of musculoskeletal diseases or injuries and poisonings of blue-collar workers. However, a smaller number of white-collar workers from larger

Table 3. Hospital visit rates by ICD-10 categories and job title

ICD-10 Disease Categories	Total case		Cases of more than 4 d visits	
	White-collar Workers	Blue-collar Workers	White-collar Workers	Blue-collar Workers
Infectious disease (A00-B99)	5.40	5.26	1.44	1.41
Neoplasms (C00-D48)	1.51	1.70	0.64	0.76
Hematologic disorder (D50-D89)	0.60	0.64	0.10	0.13
Endocrine, metabolic disease (E00-E90)	1.81	1.64	0.72	0.67
Mental disorder (F00-F99)	0.80	1.01	0.27	0.39
Nervous disease (G00-G99)	0.97	1.34	0.18	0.29
Eye disease (H00-H59)	7.68	7.85	1.47	1.59
Ear disease (H60-H95)	2.48	2.79	0.77	0.81
Circulatory disease (I00-I99)	3.52	3.70	1.83	1.85
Respiratory disease (J00-J99)	30.26	32.76	7.92	8.76
Digestive disease (K00-K93)	28.46	31.54	8.02	9.32
Dermatologic disease (L00-L99)	8.22	8.98	2.15	2.47
Musculoskeletal disease (M00-M99)	7.05	10.75	2.47	3.88
Genitourinary disease (N00-N99)	6.15	6.67	1.95	2.06
Pregnancy, puerperium (O00-O96)	2.03	0.64	0.85	0.26
Perinatal condition origi n(P00-P96)	0.01	0.00	0.00	0.00
Congenital disorder (Q00-Q99)	0.04	0.03	0.01	0.01
Symptoms and signs (R00-R99)	2.19	2.71	0.21	0.28
Injury and poisoning (S00-T98)	9.06	14.81	2.37	4.42
Health service related (Z00-Z99)	1.18	0.64	0.34	0.13
Total	119.43	135.48	33.71	39.49

* rate=No. of cases/100 person-years.

Table 4. Hospital visit rates of all disease cases and musculoskeletal, injury and poisoning cases for age, sex and company size by work type

		All disease cases		Musculoskeletal, Injuries and poisonings	
		White-collar Workers	Blue-collar Workers	White-collar Workers	Blue-collar Workers
Age	–20	1.52	7.69	0.43	1.21
	20–29	22.21	16.64	1.84	2.80
	30–39	21.17	24.13	2.89	5.04
	40–49	48.51	55.33	7.79	11.49
	50–59	74.98	71.74	12.77	16.14
	60–	80.99	57.07	14.71	13.74
Gender	Female	34.27	66.23	3.77	13.00
	Male	33.49	31.32	5.24	6.87
Company size	< 50	34.62	35.64	4.89	8.28
	50–299	33.71	41.24	4.85	8.60
	300–	29.90	42.91	4.52	7.72
Total		33.71	39.49	4.83	8.30

* rates= No. of visits/100 person-years.

Table 5. Multiple logistic regression for workers who had visited hospital and hospital visits with musculoskeletal disorders (M code) and injuries and poisonings (S, T codes)

	Workers visiting hospitals		Hospital visits ofM or S,T cases	
	Estimated Odds Ratio	95% C.I.*	Estimated Odds Ratio	95% C.I.
Age	1.100	1.098–1.102	1.010	1.009–1.011
Female	1.715	1.642–1.791	0.801	0.783–0.819
Blue-collar workers	1.129	1.082–1.178	1.507	1.465–1.552
Small Size Co.**	0.682	0.648–0.717	1.212	1.176–1.249
Middle Size Co.**	0.988	0.939–1.038	1.092	1.060–1.124

*CI; Confidence Interval. ** reference; Large Size Co.(OR;1.0).

Table 6. Some estimated occupational injury rates by types of disease category

	Frequency rate	Injury rate	Incidence rate
MST*	13.53	2.10	3.47
ST**	8.00	1.55	2.05
Korean Official rate	4.57	1.19	1.57–1.97***
Estimated rate	12.57–18.1	2.74–3.29	3.62–5.44

*MST: rates using musculoskeletal disease or injuries and poisoning categories. *ST: rates using only injuries and poisoning categories. *** estimated from the ratio of official injury rate to ST, MST injury rate.

companies sought treatment (Table 4).

Factors influencing hospital visits

Multiple logistic regression results revealed that older workers, women workers and blue-collar workers were more likely to seek medical care (see OR>1 in Table 5). When large companies were used as the reference condition in this analysis, employees of small companies were less likely to seek medical treatment, than those of large companies; however, there was no difference between small and medium-sized companies.

Women workers were less likely to seek treatment for musculoskeletal diseases or injuries and poisonings than men workers, which is in contrast with the higher probability of seeking medical treatment for overall health problems in women. The odds ratio for blue-collar workers was 1.507 for musculoskeletal diseases or injuries and poisonings, and this is higher than the 1.129 for all health problems. Smaller company workers had more frequent hospital visits for musculoskeletal diseases or injuries and poisonings.

Comparison between work injuries and illnesses underreported and official statistics

The difference in work-related injuries and illnesses unreported to the IACI between the two groups was compared. The official average injury rate in the manufacturing industry was 1.19 per 100 workers during the study period and the frequency rate was 4.57. However, the injury rate estimated from both IACI and the official rate ranged from 2.74 to 3.29 per 100 workers, and the estimated frequency rate ranged from 12.57 to 18.1 in this study. The incidence rate per 100 workers was estimated to range from 3.62 to 5.44 (Table 6).

Discussion

There are only a few studies on the reasons for underreported work-related injuries and illnesses in Korea. Conway and Svenson cited sheer neglect of the records, poor communication between different departments, management bonuses for promotion tied negatively to injury, employee group awards or bonuses for no injuries, promotion opportunity denied to employees who report an injury, and subjection of employees as reasons for underreporting of work injuries in their report[17]. These reasons can also be applied to Korea. In addition, it is generally believed that almost all serious occupational injuries are claimed via IACI, because of settling disputes between employers and injured employees, although minor injuries and illnesses were left out of the report. This trend is also reflected in our study through the low frequency rate, but high severity and mortality rates.

The NHI program in Korea, launched in 1977, became available to the entire population in 1989. Individuals insured under the NHI plan must pay 20% of the costs

related to hospitalization and 30% to 50% of the costs related to outpatient medical service[18]. Work-related injuries and illnesses, however, are not covered by the NHI plan. Nevertheless, injured workers seek treatments at the NHI to reduce medical expenditure, even though employers pay for it. It is generally assumed that many work related injuries or illnesses unreported to IACI are treated under the NHI plan.

The present study focused on musculoskeletal disease or injuries and poisonings in the NHI claims submitted by white collar and blue collar workers. We assumed that the rate difference is closely related to underreported occupational injuries, and this assumption is critically important for this study. This study suggests the following three resuls which support our assumption:

First, there was little difference in the incidence of diseases other than musculoskeletal disease or injuries and poisonings between white collar and blue collar workers (Table 3). Although the incidences of digestive disease and respiratory disease were higher in blue-collar workers, the ratios of these diseases to total hospital visits were not significantly different between the two groups.

Second, logistic regression results showed that the odds ratio for blue collar workers was 1.507 for musculoskeletal disease or injuries and poisonings, which was higher than the odd ratio of 1.129 for all health problems. The odds ratios for workers working at small- and medium-sized companies were high at 1.212 and 1.092, respectively. This finding is consistent with empirical data, showing that the prevalence of occupational injuries is high among small companies (Table 5).

Third, the odds ratio of female workers for musculoskeletal diseases or injuries and poisonings was 0.801, whereas it was 1.715 for all health problems. This finding is consistent with the general belief that male workers experience more dangerous workplace exposures than female workers.

Given these three findings, the assumption that the high incidence of musculoskeletal disease or injuries and poisonings among blue-collar workers is related to their work seems to be acceptable.

Based on these results, the rates of work related injuries were estimated and compared with the official statistics to evaluate the potential magnitude of underreporting. The occupational injury frequency rate in Japan was 4.57 in the official statistics, while it was 0.97 for manufacturing industry. However, the rate would increase the rate in the range of 12.57 to 18.1. The official severity rate for manufacturing industry was 2.58 in Korea and 0.11 in Japan, which is 23.5 times lower. Considering the ratio of severity rates between Korea and Japan, the frequency rate of 12.57 to 18.1 in this study, appears to be more reliable than the official rate of 4.57[2, 10].

A comparison of incidence rates of occupational injury and illness between Korea and the US is difficult because of the different statistical methods used by these two countries. In this study, the incidence rate was estimated to range from 3.62 to 5.44 per 100 workers, while the incidence rate of the US manufacturing Industry was 2.1 per 100 workers during the study period[11]. This finding is likely to be realistic, since Ahn *et al*[13]. reported that the mortality rate in the Korean manufacturing sector was 13.4 per 100 workers, whereas that of the US was 3.1 per 100 workers.

The published official injury rate in Korean manufacturing industry was 1.19 per 100 workers, while the injury rate established in this study was in the range of 2.74 to 3.29 per 100 workers, 2.3 to 2.8 times greater than the official rate. According to the assumptions made in this study, underreported work-related injuries and illnesses are expected to be 1.5 times higher than the official rate.

Since most subjects worked at manufacturing sites, there seemed to be no possibility of overestimating work related injuries. A high mortality rate is observed in mining, agriculture, forestry and fishing, and the construction industry, but these industries were not included in this study[10].

The findings of the present study are subject to several limitations. First, the difference in the incidence of musculoskeletal diseases or injuries and poisoning between white-collar and blue-collar workers was assumed to be due to work-related injuries and illnesses. However, in spite of supporting evidence, this assumption may be challenged.

Second, the classification of job types could be ambiguous and white-collar workers can also have work-related injuries and illnesses. The possibility of including some blue-collar workers in the category of white-collar workers would eventually reduce the magnitude of work related injuries and illnesses underreported. However, there was no possibility of including white-collar workers in the category of blue-collar workers, because the latter group included only workers who took the specific health examination. Moreover, white-collar workers could get work-related injuries, reducing the magnitude of estimation. As a result, the estimated magnitude of work related injuries and illnesses might be less than that reported here.

Third, about 27.6% of workers were excluded from this study which could have resulted in bias. Therefore, we calculated the incidence of musculoskeletal diseases or injuries and poisonings. The incidence rate for blue-collar workers who took the general health examination was 6.74 per 100 person-years (Tables 1 and 4). This was midway between the incidences of white-collar workers and blue-collar workers. The incidence rate of white-collar workers, who took the specific health examination, was 8.06 per 100 person-years (Tables 1 and 4), and it was almost same

as that of blue-collar workers. Since the general health examination is usually for white-collar workers, while the specific health examination is only for blue-collar workers in Korea, this could imply misclassification; in other words, some workers who took the general health examination might actually have been white-collar workers, and some white-collar workers who took the general health examination might have been blue-collar workers. In conclusion, exclusion of study subjects would reduce misclassification bias.

Fourth, it is not fair to generalize occupational injury and illness rates across the country because the present study was conducted in only a certain part of Korea. The Gyeongin area contains the first industrial complex built in Korea and has more labor intensive industries than other areas. Therefore, the occupational injury rate is slightly higher than other areas. Nevertheless, the tendency that injured workers claim through NHI instead of IACI is similar to other parts of Korea. Consequently, these results have limitations regarding generalization of the occupational injury rate; however, the magnitude of underreporting might be acceptable.

Despite these limitations, the present study suggests that the magnitude of work related injuries and illnesses that went underreported is as high as the official figure, leading to the conclusion that the actual occupational injury and illness rate would in fact be 2 to 3 times higher than that reported in the official statistics.

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Referencs

1) OECD. Chapter 4. Occupational accidents in OECD countries. In: OECD. Employment Outlook 1989. (online), available from <http://www.oecd.org/dataoecd/63/54/3888265.pdf> , (accessed 2006-12-30).
2) Japan Ministry of Health, Labour and Welfare. Industrial Accident Trend Survey. Japan Ministry of Health, Labour and Welfare, 2001. (online), from available from <http://www.jicosh.gr.jp/english/statistics/2001doukou-text.html>, (accessed 2006-12-30).
3) Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Health and Safety. Workers Health Chartbook, 2004. Cincinnati, OH: NIOSH Publication Dissemination, 2004: 291–311.
4) Azaroff LS, Levenstein C and Wegman DH: Occupational injury and illness surveillance: conceptual filters explain underreporting. Am J Public Heath 9, 1421–1429 (2002)
5) Pransky G, Snyder T, Dembe A and Himmelstein J: Under-reporting of work-related disorders in the workplace: a case study and review of the literature. Ergonomics 42, 171–182 (1999)
6) Weddle MG: Reporting occupational injuries: the first step. J Safety Res 27, 217–223 (1996)
7) Shannon HS and Lowe GS: How many injured workers do not file claims for workers' compensation benefits? Am J Ind Med 42, 467–473 (2002)
8) Korean Government. Industrial Accident Compensation Insurance Act. 1994.
9) Federation of Korean Trade Unions. Proceeding of open forum for renovation of Industrial Accident Compensation Insurance in Korea. Federation of Korean Trade Unions. 2002.
10) Korea Ministry of Labor. 2001 Statistics of Industrial Accidents. Seoul: Korea Ministry of Labor, 2002.
11) US Department of Labor. News. Workplace Injuries and Illnesses in 2001. Washington, DC: Bureau of Labor Statistics, 2002.
12) US Department of Labor. Census of Fatal Occupational Injuries Profiles data1992–2001. Washington, DC: Bureau of Labor Statistics, 2003.
13) Ahn YS, Bena JF, Bailer AJ.Comparison of unintentional fatal occupational injuries in the Republic of Korea and the United States of America. Injury Prevention 2004;10:199–205
14) Korea Ministry of Labor. Enforcement Regulations for Industrial Safety and Health Act. Seoul: Korea Ministry of Labor, 2003
15) Korea National Statistical Office. Korean Standard Classification of Diseases, 4th ed. Seoul: Korea National Statistical Office, 2004.
16) SAS Institute, Inc. SAS proprietary software release 9.1: SAS system help. Cary, NC: SAS Institute, Inc, 2004.
17) Conway H and Svenson J: Occupational injury and illness rates, 1992–96: why they fell. Monthly Labor Review 121, 36–58 (1998)
18) National Health Insurance Corporation. National Health Insurance Program of Korea. Seoul: National Health Insurance Corporation, 2005.