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Incidence rates of injury, musculoskeletal, skin, pulmonary and chronic diseases among construction workers by classification of occupations in South Korea: a 1,027 subject-based cohort of the Korean Construction Worker's Cohort (KCWC)

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ABSTRACT

Background: The objective of this study is to investigate the differences in incidence rates of targeted diseases by classification of occupations among construction workers in Korea.

Methods: In a subject-based cohort of the Korean Construction Worker's Cohort, we surveyed a total of 1,027 construction workers. As occupational exposure, the classification of occupations was developed using two axes: construction business and job type. To analyze disease incidence, we linked survey data with National Health Insurance Service data. Eleven target disease categories with high prevalence or estimated work-relatedness among construction workers were evaluated in our study. The average incidence rates were calculated as cases per 1,000 person-years (PY).

Results: Injury, poisoning, and certain other consequences of external causes had the highest incidence rate of 344.08 per 1,000 PY, followed by disease of the musculoskeletal system and connective tissue for 208.64 and diseases of the skin and subcutaneous tissue for 197.87 in our cohort. We especially found that chronic obstructive pulmonary disease was more common in construction painters, civil engineering welders, and civil engineering frame mold carpenters, asthma in construction painters, landscape, and construction water proofers, interstitial lung diseases in construction water proofers.

Conclusions: This is the first study to systematically classify complex construction occupations in order to analyze occupational diseases in Korean construction workers. There were differences in disease incidences among construction workers based on the classification of occupations. It is necessary to develop customized occupational safety and health policies for high-risk occupations for each disease in the construction industry.

Keywords: Korean Construction Worker's Cohort (KCWC); Subject-based cohort; Classification of occupations; Incidence rates; Occupational diseases

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BACKGROUND

The construction industry has a higher disease burden on its workers than other industries.[1,2] According to Korea's employment and labor statistics, the number of occupational injuries and illnesses per 100 construction workers has steadily increased from 0.84 in 2015 to 1.17 in 2020. Furthermore, the number of occupational fatality per 10,000 construction workers has steadily increased from 1.76 in 2015 to 2.48 in 2020.[3] Despite of the increasing health threat to Korean construction workers, the epidemiology of integrated Korean construction workers' diseases has not yet been studied. In the United States and some European countries, there are many epidemiological studies conducted about work-related disease burdens in construction industry.[4-8] It has been reported that musculoskeletal diseases, skin diseases, respiratory diseases, injury, certain other consequences of external causes occur frequently among construction workers.[7-9]

There are several kinds of occupations in the construction industry. There are 126 occupations in the Korean construction industry based on the unit wages by job family in 2022.[10] Each type of occupations is exposed to a variety of different risk factors, depending on their characteristics of job type and working environment.[11-13] Various diseases occur depending on the occupations due to the difference of the exposed risk factors. However, few studies focused on these differences by classification of occupations in the construction industry. Previous studies on the health effects in the construction industry have focused on specific diseases such as rheumatologic diseases, sarcoidosis, lung cancer, or skin diseases[14-18] or specific risk factors such as asbestos or ergonomic factors.[19,20] These studies did not cover all occupations in the construction industry.

To understand the health status of construction workers in Korea, it is necessary to understand the differences of health burden by classification of occupations in the construction industry. Such findings may be useful in customized preventing health problems in all construction occupations. Therefore, it is necessary to systematically classify construction industry worker's occupations. The Korean Construction Worker's Cohort (KCWC) was established at 2018 due to this necessity. This paper was based on the 1,027 subject-based cohort, a sub-cohort of KCWC, and analyzed to find out the health status based on classification of occupations among workers in construction industry.

METHODS

Cohort study design and job exposure assessment survey

This study used data from the KCWC established in 2018. The KCWC was designed as a hybrid of a subject-based cohort and a data-based cohort using nationwide representative data. From 2018 to 2019, 1,027 construction workers who visited the Busan branch of the Construction Workers' Mutual Aid Association (CWMAA) were recruited for the subject-based cohort. We conducted a survey on construction workers who are over 20 years old and have objectively proven occupational history in the construction industry for at least one year through the retirement mutual aid fund of CWMAA. This survey was conducted face-to-face by trained two investigators. The questionnaire included socio-demographic information (including sex, age, height, weight, and resident registration number), medical history (disease morbidity likewise hypertension, diabetes mellitus, dyslipidemia, stroke, ischemic heart diseases, osteoarthritis, etc.), lifestyle (smoking and drinking habit), and occupational history, etc.

The occupational history included not only careers in the construction industry, but also careers in other industries. Essentially, the relevant occupation's starting date (year-month) and working period were investigated. For occupational history in other industries, occupations according to the 6th Korean Standard Classification of Occupations,[21] industries according to the 9th Korean Standard Industrial Classification[22] were investigated. For occupational history in the construction industry, construction businesses, job types, and hazardous material exposure were investigated in depth. We classified construction worker's occupations systematically based on construction businesses and job type. Each construction worker's classification of occupations was determined by the occupation with the longest employment. There were total of 106 classifications of occupations. Construction businesses were surveyed according to classification based on Korean enforcement decree of the framework act on the construction industry. Job types were surveyed according to a 2018 survey report on the unit wages of the construction industry by the Construction Association of Korea.[10] Classifications of construction businesses and job types are shown in **Supplementary Table 1**. Working duration was classified according to the skill class system (beginner [< 3 years], intermediate [≥ 3, < 9 years], advanced [≥ 9, < 21 years], and expert [≥ 21 years]).[23]

Data linkage: National Health Insurance Service (NHIS) data and case inclusion

The National Health Insurance (NHI) database, formed by the NHIS, is a nationwide public information data on health care utilization, health screening, socio-demographic variables, and disease morbidity for almost the entire population of South Korea.[24] We obtained the "Customized health information data" from the NHIS using resident registration numbers.[25] Through integrated literature reviews, we evaluated eleven target disease categories with high prevalence or estimated work-relatedness among construction workers. Injuries, poisonings, musculoskeletal diseases, skin diseases, and respiratory diseases (emphysema, chronic obstructive pulmonary disease [COPD] [except MacLeod's syndrome with diagnosis code J43.0], asthma and interstitial lung diseases) were chosen as study target diseases.[7-9] In addition, cancers, general chronic diseases (hypertensive diseases and diabetes mellitus) and overwork-related diseases (ischemic heart diseases and stroke) were chosen[26] to understand the overall health burden of the construction workers.

We examined the disease occurrence in the NHI claim data of 1,027 construction workers from 2002 to 2018. It made used of the seventh revision of the Korean Classification of Diseases (KCD-7). KCD-7 is the Korean version of the World Health Organization's International Classification of Diseases, 10th Edition.[27] **Fig. 1** depicts the study design. To define a new occurred disease, all participants had past history period. We excluded the workers attacked cases within past history period before the first employment. The past period were mostly 3 years of all diseases (except: injuries and skin diseases had not past history period). For accuracy, we selected the disease code in both the inpatient and outpatient medical charts but severe diseases such as cancers, ischemic heart diseases, and stroke were searched from

First point of
enrolled subjects

Disease outbreak
index point

End point of
follow-up

Past history period   Follow-up period

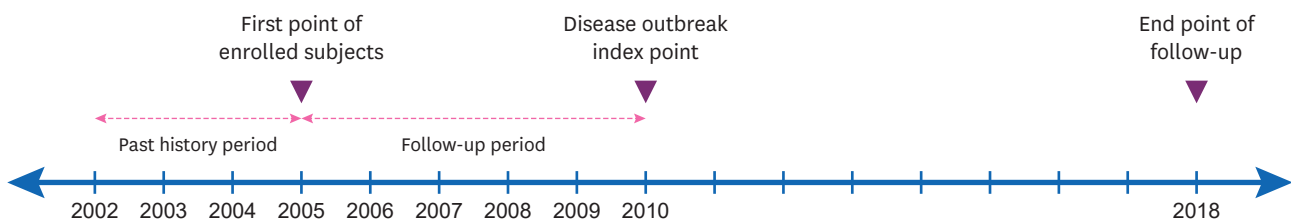2002 2003 2004 2005 2006 2007 2008 2009 2010   2018

Fig. 1. Subject-based cohort study design in Korean Construction Worker's Cohort. Example of a new onset disease in 2010 in a person who started working in construction industry since 2005.

only inpatient medical charts. In addition, stroke patients were enrolled only with computed tomography or magnetic resonance imaging prescription codes. Only those with hypertensive diseases and diabetes mellitus who took medications at least twice a year for three years during the observation period were enrolled (**Supplementary Table 2**).

Statistical analysis

Based on the survey results, basic socio-demographic characteristics and occupational history in the construction industry were extracted and descriptive analysis with stratification was performed. Age and work duration were expressed as mean ± standard deviation. The independent t-test and χ^2 test were used to compare the sex differences. A *p*-value of < 0.05 was considered statistically significant. The mean follow-up period and the average incidence rates for each disease were calculated. The mean follow-up period was calculated as total of each period from the beginning of observation to the occurrence of diseases divided by the occurrence number of diseases. Average incidence rates were calculated as below.

$$\text{Average incidence rate (per 1,000 person-years)}$$

$$= \frac{\text{Number of new cases of a target diseases occurring in a population during observation period}}{\text{Total person-years (the sum of the time periods of observation of each person)}}$$

The average incidence rates were calculated based on classification of occupations. We examined twelve occupations out of 106; 6 job types in construction (frame mold carpenters, concrete reinforcing iron workers, bricklayers, water proofers, plasterers, and painters), three job types in civil engineering (frame mold carpenters, concrete reinforcing iron workers, and welders) and three construction businesses (plant, landscape, and specialized construction). When selecting a classification of occupations for analysis, we considered the frequency and the degree of exposure to risk factors. All statistical analyses were performed using SPSS software v26 (IBM, Armonk, NY, USA) for Windows.

Ethics statement

The study was carried out in accordance with the Helsinki Declaration, and was approved by the Pusan National University Yangsan Hospital's Institutional Review Board Committee (IRB No. 04-2018-014 and date of approval was June 18, 2018). All subjects provided informed consent when they were surveyed and enrolled.

RESULTS

The general and occupational characteristics of the subject-based cohort in KCWC

From 2018 to 2019, we surveyed 1,029 workers, with 2 of them being excluded due to duplicates. So, a total of 1,027 enrollees of cohort were analyzed. **Table 1** showed basic socio-demographic and occupational characteristics. The average age of all workers was 59.3 years old. The average age of female was 61.1 years, which was older than that of male (59.2 years). The proportion of smoker (current and ex-smoker) in male was 82.3%, which was significantly higher than that of females (7.7%).

In classification of 5 construction industry businesses, construction was the most common (64.7%) and the landscaping was the lowest proportion (2.8%). Males were more likely to

Table 1. Socio-demographic and occupational characteristics of the subject-based cohort in Korean Construction Worker's Cohort

Variable	Total (n = 1,027)		Male (n = 949)		Female (n = 78)		p-value
	No.	%	No.	%	No.	%	
Age (years)							
Mean ± SD	59.3 ± 8.9		59.2 ± 9.0		61.1 ± 6.9		0.022*a
< 30	9	0.9	8	0.8	1	1.3	0.512b
30–39	28	2.7	27	2.8	1	1.3	
40–49	110	10.7	102	10.7	8	10.3	
50–59	256	24.9	241	25.4	15	19.2	
60–69	530	51.6	488	51.4	42	53.4	
≥ 70	94	9.2	83	8.7	11	14.1	
Smoking							< 0.001***b
Smoker	845	82.3	839	88.4	6	7.7	
Non-smoker	182	17.7	110	11.6	72	92.3	
Body mass index (kg/m²)							0.021*b
Under weight (< 18.5)	19	1.8	14	1.5	5	6.4	
Normal weight (≥ 18.5, < 25.0)	734	71.5	681	71.8	53	67.9	
Over weight (≥ 25.0, < 30.0)	258	25.1	239	25.2	19	24.4	
Obesity (≥ 30.0)	16	1.6	15	1.6	1	1.3	
Construction businesses							< 0.001***b
Construction	664	64.7	608	64.1	56	71.8	
Civil engineering	142	13.8	137	14.4	5	6.4	
Plant	72	7.0	66	7.0	6	7.7	
Landscape	29	2.8	20	2.1	9	11.5	
Specialized construction	120	11.7	118	12.4	2	2.6	
Work duration in construction industry (years)							
Mean ± Standard deviation	19.2±13.1		19.9±13.2		11.4±8.7		0.001**a
Beginner (< 3 years)	99	9.6	80	8.4	19	24.4	< 0.001***b
Intermediate (≥ 3, < 9 years)	180	17.5	164	17.3	16	20.5	
Advanced (≥ 9, < 21 years)	328	31.9	299	31.5	29	37.2	
Expert (≥ 21 years)	420	40.9	406	42.8	14	17.9	

Current and ex-smokers are both classified as smokers. The p-values were calculated by t-test for continuous variables and χ² for categorical variables.
*p < 0.05, **p < 0.01, ***p < 0.001.
[a]The p-values were calculated using an independent sample t-test.
[b]The p-values were calculated using Pearson's χ² test.

work in civil engineering or specialized construction than females. Distribution of job types in each construction industry business is presented in **Supplementary Tables 3**-**7**. In the construction and civil engineering, frame mold carpenters except for others accounted for a large portion with 24.5% and 30.8%, respectively. The workers have worked for more than 21 years were the most (40.9%) in total subjects. The average working duration of male workers was 19.9 years, which was significantly longer than that of females (11.4 years).

Mean follow-up period and incidence rates for targeted diseases in the subject-based cohort of KCWC

In cohort, the follow-up period for interstitial lung diseases was the longest for 10.35 years, followed by ischemic heart diseases for 10.30 years, stroke for 10.26 years (**Table 2**). The follow-up period for injury, poisoning, and certain other external causes was the shortest for 2.62 years.

Among targeted diseases, the highest incidence rate was 344.08 per 1,000 person-years (PY) in injury, poisoning, and certain other external causes. The second was the diseases of the musculoskeletal system and connective tissue as 208.64 per 1,000 PY and third was the diseases of the skin and subcutaneous tissue as 197.87 per 1,000 PY. There was a sex difference that the diseases of the musculoskeletal system and connective tissue in male and diseases of the skin and subcutaneous tissue in female were the second highest in each sex (**Table 2**).

Table 2. Mean follow-up period and targeted disease incidence rates of the subject-based cohort in Korean Construction Worker's Cohort

Disease	KCD-7	Sex	Mean follow-up period (years)	Number of events	Total person-years	Incidence rates (per 1,000 person-years)
Total cancer	C00-097	Total	10.14	46	10,167	4.52
		Male		41	9,509	4.31
		Female		5	658	7.60
Injury, poisoning, and certain other consequences of external causes	S00-T98	Total	2.62	907	2,636	344.08
		Male		841	2,472	340.21
		Female		66	164	402.44
Diseases of the musculoskeletal system and connective tissue	M00-99	Total	4.27	425	2,037	208.64
		Male		414	2,002	206.79
		Female		11	35	314.29
Diseases of the skin and subcutaneous tissue	L00-99	Total	4.10	816	4,124	197.87
		Male		749	3,949	189.67
		Female		67	175	382.86
Allergic contact dermatitis	L23	Total	6.90	532	6,940	76.66
		Male		484	6,566	73.71
		Female		48	374	128.34
Irritant contact dermatitis	L24	Total	9.29	193	9,344	20.66
		Male		174	8,768	19.85
		Female		19	576	32.99
Undifferentiated contact dermatitis	L25	Total	9.62	136	9,676	14.06
		Male		126	9,058	13.91
		Female		10	618	16.18
Emphysema and other chronic obstructive pulmonary diseases	J43-44 (Except J43.0)	Total	10.03	66	9,969	6.62
		Male		63	9,302	6.77
		Female		3	667	4.50
Asthma	J45-46	Total	9.05	242	8,430	28.71
		Male		226	7,982	28.31
		Female		16	448	35.71
Interstitial lung diseases	J84	Total	10.35	3	10,414	0.29
		Male		3	9,727	0.31
		Female		0	687	0.00
Hypertensive diseases	I10-13, I15	Total	9.35	150	8,235	18.22
		Male		140	7,714	18.15
		Female		10	521	19.19
Diabetes mellitus	E10-14	Total	10.07	53	9,262	5.72
		Male		51	8,667	5.88
		Female		2	595	3.36
Ischemic heart diseases	I20-25	Total	10.30	18	10,324	1.74
		Male		17	9,646	1.76
		Female		1	678	1.48
Stroke	I60-69	Total	10.26	27	10,272	2.63
		Male		26	9,585	2.71
		Female		1	687	1.46

KCD-7: seventh revision of the Korean Classification of Diseases.

Incidence rates for targeted diseases based on the classification of occupations in the subject-based cohort of KCWC

The incidence rates for targeted diseases of a total of 1,027 people in the cohort were compared and analyzed according to the classification of occupations with high frequency (**Table 3**, **Fig. 2**). Total cancer was not analyzed due to the small number of subjects. In **Table 3**, the occupations with the highest incidence rate for each target disease were boldly labeled from first to third. The occupations with the highest incidence rate for each target disease were indicated by red dots from first to third in **Fig. 2**. The incidence rate for injury, poisoning, and certain other consequences of external causes was the highest in civil engineering welders at 619.05 per 1,000 PY. The incidence rate for diseases of the musculoskeletal system and connective tissue was the highest in construction bricklayers at

Table 3. Targeted disease incidence rates based on classification of occupations of the subject-based cohort in Korean Construction Worker's Cohort

Classifications of occupations	Diseases and diagnostic codes, incidence rates for diseases (per 1,000 person-years)									
	Injury, poisoning, and certain other consequences of external causes	Diseases of the musculoskeletal system and connective tissue	Diseases of the skin and subcutaneous tissue	Emphysema and other chronic obstructive pulmonary diseases	Asthma	Interstitial lung diseases	Hypertensive diseases	Diabetes mellitus	Ischemic heart diseases	Stroke
	S00-T98	M00-99	L00-99	J43-44 (Except J43.0)	J45-46	J84	I10-13, I15	E10-14	I20-25	I60-69
Construction										
Frame mold carpenters	357.70	197.61	198.10	6.71	30.50	0.00	24.50	7.69	1.79	2.39
Concrete reinforcing iron workers	375.00	218.49	258.07	7.10	27.95	0.00	18.21	1.54	0.00	1.39
Bricklayers	188.41	571.43[a]	327.27[a]	10.31	20.69	0.00	27.21[a]	10.64[a]	0.00	5.10[a]
Water proofers	558.82[a]	333.33[a]	310.35[a]	10.26	56.74[a]	4.70[a]	30.12[a]	9.85[a]	4.59[a]	0.00
Plasterers	240.00	171.88	194.44	2.76	24.69	0.00	20.76	9.32	0.00	2.73
Painters	388.89	500.00[a]	183.10	16.53[a]	67.80[a]	0.00	53.33[a]	10.53[a]	7.69[a]	0.00
Civil engineering										
Frame mold carpenters	361.35	222.22	212.77	12.45[a]	40.63	0.00	11.11	2.04	3.88[a]	0.00
Concrete reinforcing iron workers	378.38	296.30	294.12[a]	5.38	40.54	0.00	24.59	5.41	0.00	11.17[a]
Welders	619.05[a]	222.22	266.67	12.99[a]	21.43	0.00	16.53	0.00	0.00	0.00
Plant	434.48[a]	219.18	199.28	8.79	19.77	1.43[a]	17.11	8.03	1.42	2.89
Landscape	428.57	200.00	211.01	11.63	59.41[a]	0.00	19.61	3.76	0.00	0.00
Specialized construction	344.83	219.73	213.24	3.95	38.99	0.00	17.08	6.17	0.93	4.77[a]

[a]Top 3 occupations for each target disease.

571.43 per 1,000 PY and the incidence rate for disease of the skin and subcutaneous tissue was the highest in construction bricklayers at 327.27 per 1,000 PY. In the respiratory diseases, the incidence rate for emphysema and other COPD was the highest in construction painters at 16.53 per 1,000 PY, asthma in construction painters at 67.80 per 1,000 PY, and interstitial lung diseases in construction water proofers at 4.70 per 1,000 PY. In chronic diseases, the incidence rate for hypertensive diseases was the highest in construction painters at 53.33 per 1,000 PY, and diabetes mellitus in construction bricklayers at 10.64 per 1,000 PY. In cardio-cerebrovascular diseases, the incidence rate for ischemic heart diseases was the highest in construction painters at 7.69 per 1,000 PY, and stroke in civil engineering concrete reinforcing iron workers at 11.17 per 1,000 PY.

DISCUSSION

In this study, we conducted a face-to-face survey to establish the subject-based cohort of KCWC. A total of 1,027 construction workers responded. Through a linkage based on the resident registration number, we combined and analyzed exposure (survey) data and their health status (NHIS) data. The incidence rate of diseases among all construction workers was the highest, at 344.08 per 1,000 PY for injury, poisoning, and certain other consequences of external causes. The next highest was diseases of the musculoskeletal system and connective tissue with 208.64 per 1,000 PY, followed by disease of the skin and subcutaneous tissue with 197.85 per 1,000 PY.

Construction workers commonly face considerable health risk due to injury, musculoskeletal diseases, and skin diseases. In our study, the incidence of injury, poisoning, and certain other consequences of external causes was the highest. We thought that this is attributed to a higher number of injuries compared to poisoning cases. In our recent study analyzed the compensation insurance data for occupational diseases among construction workers in Korea from 2009 to 2018, the cases of poisoning were fewer claims than injuries such as

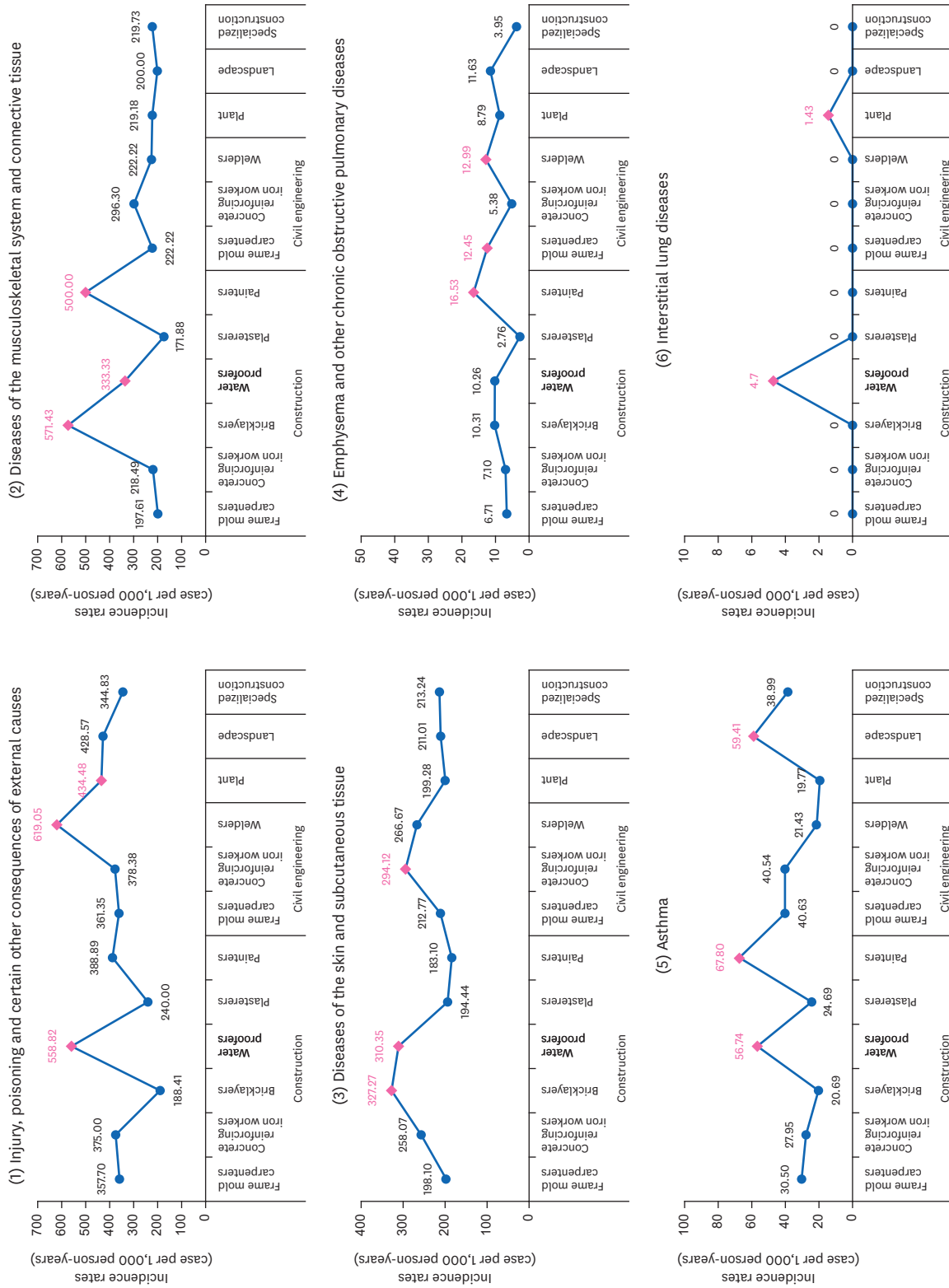**Fig. 2.** Target disease incidence rates based on classification of occupations of the subject-based cohort in Korean Construction Worker's Cohort.
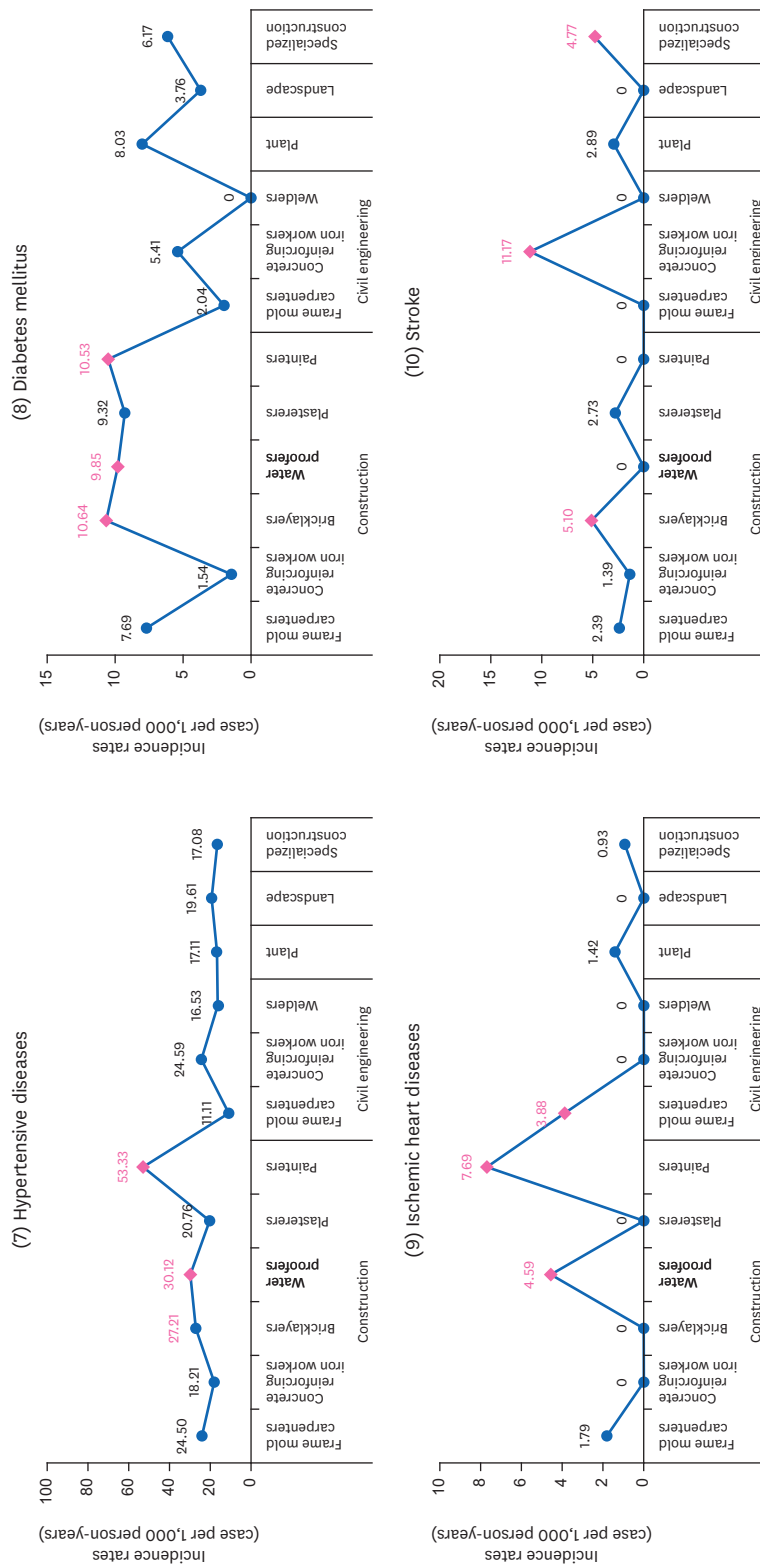
Fig. 2. (Continued) Target disease incidence rates based on classification of occupations of the subject-based cohort in Korean Construction Worker's Cohort.

rupture, laceration, amputation and abrasion.[28] A German cohort study reported that male construction workers had a significantly higher standardized incidence rate ratio (SIRR) of disability from injuries for (SIRR: 2.5) and musculoskeletal diseases (SIRR: 2.16) and higher but not significant SIRR of disability from skin diseases (SIRR: 1.61) in comparison with general work force.[29] A United Kingdom cohort study found the significantly higher SIRRs of musculoskeletal disorders (SIRR: 1.9) and skin disorders (SIRR: 1.6).[7]

We also compared and analyzed the disease incidence rates according to the classification of occupations based on construction businesses and job types. For injury, poisoning, and certain other consequences of external causes, civil engineering welders; for diseases of the musculoskeletal system and connective tissues, construction; for skin and subcutaneous tissue diseases, construction bricklayer showed the highest incidence rate. Previous studies also reported various occupations with high incidence of these diseases. There were significantly higher SIRR of disability from accidents for carpenters (SIRR: 2.31), plasterers (SIRR: 3.00), and bricklayers (SIRR: 1.63) compared with blue collar workers.[29] In United Kingdom, there were significantly higher SIRR of disability due to musculoskeletal disorders for welders (SIRR: 1.7), road construction operatives (SIRR: 6.1) than other workers. In addition, there were significant higher SIRR of contact dermatitis for metalworking production and maintenance fitters (SIRR: 1.4) and construction trades n.e.c. (SIRR: 1.4).[11] Injury and musculoskeletal disease were the major causes of worker's compensation claims in the construction industry.[28] This may be because of the dangers of the construction site, excessive workload, and inappropriate safety perception. Common occupational hygiene interventions for the construction industry are required rather than a detailed classification of occupations.[30,31] Occupational skin diseases were correlated with high-temperature exposure and skin contact with chemical products. Specifically, high-temperature exposure was significantly

associated with the construction industry.[32] Among construction workers, high incidence rates were reported for floor layers, tile setters, bricklayers, concrete placers, and concrete finishers. 71% of these cases were allergic contact dermatitis and more than half of allergic contact dermatitis was due to epoxy chemical.[33] Future studies assessing heat exposure and skin contact with chemical products in the classification of occupations and identifying risk factors will facilitate reduction of occupational skin diseases in construction workers.[28]

For asthma, construction painters, construction water proofers, and landscape workers showed a higher incidence rate than other occupations in this study. There were significantly higher SIRR of asthma for welding trades (SIRR: 4.7), metalworking production and maintenance fitters (SIRR: 2.0) and painters and decorators (SIRR: 1.9) in other study. In addition, chest physicians picked wood and wood dust, paints and dyes and isocyanate as suspected causal agents for asthma among construction workers.[11] These substances could be suspected as the causative agents of classification of occupations with a high incidence rate for asthma in this study. These results warrant the need of research to explore and manage the relevant allergic substance exposures.

Previous studies have shown an increased risk in construction workers for chronic pulmonary diseases such as COPD and interstitial lung diseases. The United States cohort study reported significantly higher adjusted odds ratio (OR) for chronic lung disease (OR: 1.93). A Sweden cohort study reported that mortality due to COPD was significantly increased by occupational exposure factors such as vapors, dusts, gases, and fumes.[34] In addition, a United States cohort study reported that high exposure to these factors was associated with a yearly decline of forced expiratory volume in 1 second and forced vital capacity.[35] In our study, construction painters had the highest incidence rate of COPD, and construction water proofers had the highest incidence rate of interstitial lung diseases. Occupational exposure to dust, fumes, and particular matters may be ascribed to the occurrence of chronic respiratory diseases in construction workers.[36,37] Thus, industrial hygiene management is required for the classification of occupations with relatively high incidence.

In this study, the incidence rates for ischemic heart diseases, stroke, hypertensive diseases and diabetes mellitus showed differences by occupations. The work-relevance of these diseases among construction workers is still unclear. There are studies that found no increasing risk of these diseases among construction workers,[4,29] but there are also study that found significantly increased relative risks (RRs) for stroke (RR: 1.85) and ischemic heart disease (RR: 1.59).[38] In addition, there are studies that investigate the influence of poor lifestyles including smoking, heavy drinking, and bad diet that are risk factors for the above diseases among construction workers,[39-41] while there is study suggested that occupational exposure to noise, cold environment, particulate air pollution and underground environment can increase the risk of cardiovascular diseases.[12,42,43] However, we think it is difficult to define the work-relevance of it because the non-occupational risk factors such as age and lifestyle contribute to high.

There were similarities and differences on disease incidence rates according to classification of occupations between studies. These may be due to differences in classification of occupations, operational definitions of target diseases, or working environments across countries, even within the same occupations. In the case of occupational injuries in the construction workers, it has been reported to be associated with various factors such as work duration, vibration tools, hazard awareness, alcohol consumption, and working environment.[42,44]

This study has several limitations. First, we had no reference group. As a result, it is difficult to find that diseases affect construction workers more frequently than the general population. This is because the subject-based cohort of KCWC focused on practically investigating the differences on disease incidence by occupations among construction industry. Further, we did not adjust confounders such as age, sex, and smoking. As the total number of subjects was 1,027, it was challenging to adjust the confounders because the number of subjects in the classification of occupations was insufficient. Particularly, because a majority of the surveys participants were male, the disease incidence rates could be seen as representative health status of male construction workers. Moreover, we did not consider changes in the type of jobs of workers in the construction industry. This was difficult to evaluate because the size of the cohort was small compared with the various classifications of occupations. However, these limitations are expected to be overcome through data-based cohorts to be reported by ours in the future. A data-based cohort, which is a sub-cohort other than a subject-based cohort of KCWC, was established following the employment insurance database and CWMAA database. This data-based cohort included more than 5 million Korean construction workers with most daily workers and comprised public officials as a control group. In that, we aimed to analyze the health effects adjusted for confounding variables following a detailed classification of occupations.

Nevertheless, our study is very meaningful in that it is the first study to examine the incidence rates of various diseases using a systematically classification of construction workers' occupations. Finding the differences in disease incidence rates among construction workers according to classification of occupations can be the first step in searching for risk factors such as hazardous work environment or substance exposures. Through face-to-face survey, we investigated exactly careers in the construction industry. In addition, we systematically classified construction workers' occupations based on the two axes of business and job type. After that, we linked the survey result and the NHIS data for the accurate diagnosis. Therefore, our subject-based cohort of KCWC can be considered as the result of linking relatively accurate exposure assessment with health status.

CONCLUSIONS

We presented the targeted disease incidence rates among Korean construction workers based on classification of occupations. The most common health problems were injuries, musculoskeletal diseases, and skin diseases. We discovered that emphysema and COPD were more common in construction painters, civil engineering welders, and civil engineering frame mold carpenters, asthma in construction painters, landscape, and construction water proofers, interstitial lung diseases in construction water proofers. It is meaningful because this is the first study that analyzed health problems of Korean construction workers by systematically classifying complex occupations. Through this subject-based study of KCWC, it is expected to be used to customized occupational safety and health policies for high-risk occupations by disease in the construction industry.

ACKNOWLEDGEMENTS

SUPPLEMENTARY MATERIALS

Supplementary Table 1

Classifications of occupations based on construction businesses and job types among construction workers

Click here to view

Supplementary Table 2

Operational definition of targeted diseases of the subject-based cohort in Korean Construction Worker's Cohort

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Supplementary Table 3

Job type distribution among construction workers in construction business

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Supplementary Table 4

Job type distribution among construction workers in civil engineering business

Click here to view

Supplementary Table 5

Job type distribution among construction workers in plant business

Click here to view

Supplementary Table 6

Job type distribution among construction workers in landscape business

Click here to view

Supplementary Table 7

Job type distribution among construction workers in specialized construction business

Click here to view

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