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Original Article

The Relationship between Hospital Selection by Employer and Disabilities in Occupational Accidents in Korea

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ABSTRACT

Background: In the event of an industrial accident, the appropriate choice of hospital is important for worker health and prognosis. This study investigates whether the choice of hospital by the employer in the case of industrial accidents affects the prognosis of injured employees.
Methods: Data from the 2018 Panel Study of Workers' Compensation Insurance in Korea were used in an unmatched case-controlled study. The exposure variable is "hospital selection by an employer," and the outcome variable is 'worker's disability." Odds ratios (ORs) were estimated by modified Poisson regression and adjusted for age, gender, underlying disease, injury severity, and workplace size and stratified by industrial classification. The group at increased risk was analyzed and stratified by age, gender, and area.
Results: In the construction industry, hospital selection by the employer was significantly associated with increased risk of disability (adjusted OR 1.26; 95% confidence interval [CI]: 1.20–1.32) and severe disability (adjusted OR 1.38; 95% CI: 1.08–1.76) among the injured. Female and younger workers not living in the Seoul capital area were more at risk of disability and severe disability than those living in the Seoul capital area.
Conclusions: Hospital selection by employers affects the prognosis of workers injured in an industrial accident. For protecting workers' health and safety, workplace emergency medical systems should be improved, and the selection of appropriate hospitals to supply treatment should be reviewed.

1. Introduction

In the event of an accident, an appropriate hospital for first aid or more extensive treatments is critical to patient prognosis [1,2]. Emergency medical systems, including the selection of an appropriate hospital according to the status of the injury observed in the prehospital setting, should be managed nationally [2,3]. Emergency delivery medical systems are important in workplaces [4,5]. Korean workplaces are required to have an emergency medical system that provides first aid treatment, training, and division of work in accordance with the Regulations on Industrial Safety Standards of the *Industrial Safety and Health Act* [6]. Regulations governing safety and health management organizations and disaster prevention specialist guidance organizations stipulate that a health management organization, in consultation with the employer, should establish a cooperative emergency medical system with a nearby medical institution to perform duties under Article 17 (1)7. The organizations are required to review the company-designated hospital in the workplace management system.

Concerns have been raised that allowing employers to choose the hospital can benefit the employer rather than prioritize the treatment of the patient [7–10]. According to a news report, workers injured on the job were encouraged not to apply for industrial accident insurance compensation but to seek compensation directly from the company [10]. In one serious case, a company forced an injured worker to use a distant company-designated orthopedic hospital, which was unable to treat the worker, who was

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transferred to another, more appropriate emergency hospital but died [11].

To our knowledge, no studies of the prognosis of injured workers treated at hospitals chosen by their employers in the case of industrial accidents have been reported. Here, we examine the relationship between the selection of a medical institution and worker prognosis, in the form of disability, in occupational accidents.

2. Materials and methods

2.1. Data collection, study participants, cases, and control selection

This study used data from the 2018 Panel Study of Workers' Compensation Insurance (PSWCI) in Korea [12]. The PSWCI data were assembled by Korea Workers' Compensation and Welfare Service Labor Welfare Research Institute for industrial accident prevention and policy establishment. The PSWCI is a nationally approved report by the National Statistical Office of the Republic of Korea. We used the first year of data (2018) from the PSWCI Second Cohort. The study population comprised 75,392 industrial workers who were injured at the workplace and ended medical care from January to December 2017, and 3,294 people were sampled by stratified probability sampling. The data included estimated weighted values of the source population. Because our study focused on paid blue-collar workers who experienced occupational accidents, we excluded workers who suffered "occupational diseases and commuting accidents" (weighted n = 3994.1), "self-employed" (Weighted n = 433.0), "not blue-collar workers" (Weighted n = 18358.8), and those considered "missing or refused providence of data" (Weighted n = 2368.1) (Fig. 1).

The participants were those who had already ended medical care, and their disability was determined at the time of evaluation of their fixed health status. When workers are disabled in an industrial accident, they receive disability benefits under the *Workers' Compensation Act* [13]. The degree of impairment is divided into 14 levels, and if an injury does not fall under any of those 14 levels, it is defined as nondisability. The first case group included participants with disability of 1 to 14 levels (weighted n = 20,129.6); control group included nondisability (weighted n = 30108.4). The second case group included participants with severe disability (weighted n = 797.4), and the control group was participants with nonsevere disability (weighted n = 49440.6). Although there is no medical standard for severe disability, the presence of severe disability was defined as degrees 1–7 based on a previous study [14]. Because only workers with a degree of disability of 1–7 can receive a disability pension, degrees 1–7 were defined as the presence of severe disability, and degrees 8–14 and nondisability were defined as the absence of severe disability.

2.2. Patient and public involvement

No patients were directly involved in this study, which used public records only.

2.3. Study variables

2.3.1. Choice of adjusted variable

For selecting variables for adjustment, a directed acyclic graph (DAG) was used in the model with DAGitty to draw causal diagrams [15,16]. DAGs show the hypothesized causal associations among hospital selection by an employer (yellow-green circle), disability/severe disability ("I" in a blue circle), and covariates (Fig. 2). The proposed adjustment variable using the DAGitty is indicated by white circles. Ancestor variables of the outcome and not proposed adjustment variables are indicated by blue circles. Adjusted variables were age, sex, underlying disease (CCI), injury severity, industrial classification, and workplace size.

2.3.2. Hospital selection by the employer

The hospital selected by an employer in each occupational accident was obtained by asking the following question: "How was the medical institution that provided treatment at the time of the industrial accident chosen?" Answers, such as "Decision made by the employer (including company's predesignated hospital)," were defined as "yes." Answers, such as "Decision made by colleagues," "Decision made by family," and "Decision made by emergency medical personnel (ex. ambulance)," were defined as "no."

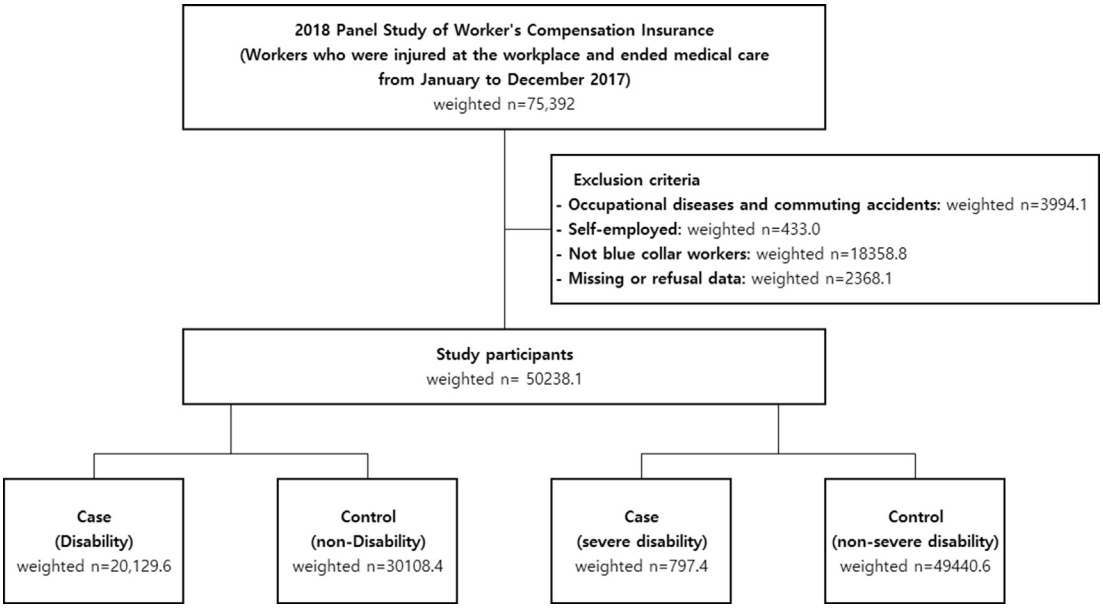

Fig. 1. Selection of participants.

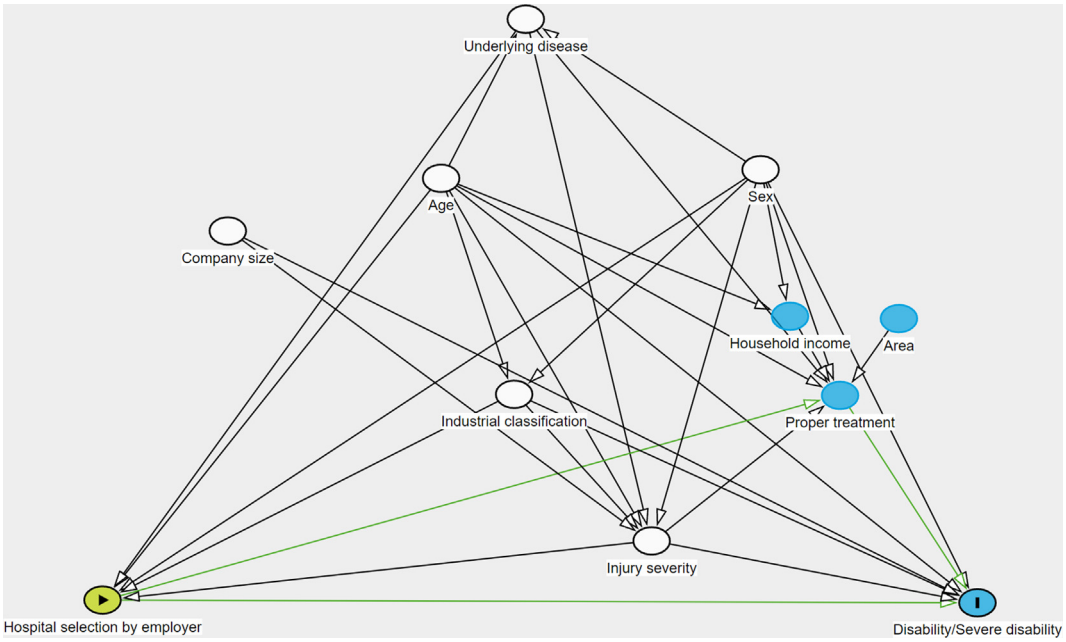

Fig. 2. Directed acyclic graphs for variable selection.

2.3.3. Other variables

Other variables included in the study were age, sex, workplace size (<5, 5–9, 10–19, 20–29, 30–99, 100–299, 300–999, or ≥ 1000 employees), and area (Seoul capital area vs. non–Seoul capital area). The industry was classified as construction, manufacturing, service-related, or other industries utilizing the Korean Standard Industrial Classification (Supplementary Table 1). The underlying disease was evaluated according to the Charlson complexity index (CCI), which is the sum of the weights of the major diseases [17–19]. Injury severity was also included. Injury scoring was divided into anatomical and physiological scoring systems [20]. The physiological scoring system could not be used because evaluations required clinical information obtained in the emergency room, such as eye opening, verbal response, motor response, systolic blood pressure, and respiratory rate. Instead, we constructed a severity scoring system according to injury type and body part using the concept of the abbreviated injury scale (AIS) (Supplementary Table 2) [21].

2.3.4. Statistical analysis

We conducted an unmatched, case-controlled study with clear temporal precedence. Hospital selection was decided immediately after an occupational accident, and the disability grade was evaluated after completion of medical care following the accident. We evaluated two relationships among the variables: the association between hospital selection by the employer and the presence of a disability and the relationship between hospital selection by the employer and the presence of a severe disability. In general, in cases of rare diseases, the odds ratio (OR) is calculated as a risk ratio by logistic regression analysis, which can be interpreted by approximating the relative risk [22]. However, because disabilities among industrial accident workers are not rare, we used modified Poisson regression instead of logistic regression [23]. First, the ratios were stratified by industry, given the large difference in association by industry [24]. Next, a group at increased risk was identified and further stratified. For identifying the interaction, stratified analysis was performed on sex, age (<40 and ≥40), and area (Seoul capital area and non–Seoul capital area) [25]. For the sensitivity analysis, cases of "decision made by emergency medical personnel" were excluded because the "decision made by emergency medical personnel" was based on professional judgment. As another sensitivity analysis, the treatment period was also used as an adjusted variable instead of our injury severity. Weighted values were used in all calculations for representativeness. Using weighted values, 2,393 study participants could represent 50,238 industrial accident workers (Fig. 1). Data were analyzed in SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

2.3.5. Ethical approval

This study was approved in an exemption of ethical revision by the Institutional Review Board of St. Mary's Hospital, The Catholic University of Korea (Exemption number: KC21ZASI0792).

3. Results

The characteristics of workers according to a disability or severe disability are shown in Table 1. There was a significant difference in hospital selection, sex, age group, injury severity, workplace size, industrial classification, and area, depending on the presence of a disability. According to severe disability, these results showed a significant difference in sex, age group, injury severity, Charlson comorbidity index, workplace size, industrial classification, and area.

Table 2 provides the ORs for disability and severe disability according to hospital selection by an employer. In the overall population, the adjusted ORs for disability were significantly positive, and those for severe disability were significantly negative. However, after stratification by industry, the adjusted ORs were similar. Both disability and severe disability showed a significant increase of risk for workers in the construction industry and significant preventive effects in those employed in the manufacturing and service-related industries. Results for workers in other industries were not significant.

Additional analysis was performed based on the construction industry (Table 3). Female workers were at greater risk of (adjusted OR, 2.40; 95% confidence interval [CI], 1.83–3.15) than male workers

Table 1
Baseline characteristics of study participants

	non-Disability (Weighted n,%)	Disability (Weighted n,%)	P-value	non-Severe disability (Weighted n,%)	Severe disability (Weighted n,%)	P-value
Overall	30108.4 (100.00)	20129.6 (100.00)		49440.6 (100.00)	797.4 (100.00)	
Hospital selection						
By others	21704.1 (72.09)	13691.6 (68.02)	<0.0001	34823.4 (70.43)	572.4 (71.78)	0.4101
By employer	8404.3 (27.91)	6438 (31.98)		14617.3 (29.57)	225.1 (28.22)	
Sex						
Male	25444.6 (84.51)	17613.9 (87.50)	<0.0001	42328.8 (85.62)	729.7 (91.51)	<0.0001
Female	4663.8 (15.49)	2515.7 (12.50)		7111.8 (14.38)	67.7 (8.49)	
Age (years)						
≤39	7353.5 (24.42)	2526.5 (12.55)	<0.0001	9786.8 (19.79)	93.2 (11.69)	<0.0001
40–49	5410.8 (17.97)	4155.4 (20.64)		9419.5 (19.05)	146.7 (18.39)	
50–59	9715.1 (32.27)	7483.5 (37.18)		16887.3 (34.16)	311.3 (39.04)	
≥60	7629 (25.34)	5964.3 (29.63)		13,347 (27.00)	246.2 (30.88)	
Injury severity						
Mild	17436.7 (57.91)	9340.9 (46.40)	<0.0001	26623.2 (53.85)	154.4 (19.36)	<0.0001
Moderate	10422.2 (34.62)	7547.9 (37.50)		17635.3 (35.67)	334.8 (41.98)	
Severe	2249.4 (7.47)	3240.9 (16.10)		5182.1 (10.48)	308.2 (38.66)	
CCI*						
0	26707.2 (88.70)	17919.8 (89.02)	0.2655	43951.9 (88.90)	675.1 (84.66)	0.0008
1	3038.4 (10.09)	1996 (9.92)		4924.6 (9.96)	109.8 (13.77)	
≥2	362.8 (1.21)	213.8 (1.06)		564.2 (1.14)	12.5 (1.57)	
Workplace size (number of workers)						
<300	23966.1 (79.60)	15,815 (78.57)	0.0052	39206.8 (79.30)	574.2 (72.01)	<0.0001
≥300	6142.3 (20.40)	4314.7 (21.43)		10233.8 (20.70)	223.2 (27.99)	
Industrial Classification						
Construction	9455.5 (31.40)	7836.7 (38.93)	<0.0001	16998.3 (34.38)	293.9 (36.86)	<0.0001
Manufacturing	8190.3 (27.20)	7419.3 (36.86)		15271.6 (30.89)	338 (42.39)	
Service related	7418.2 (24.64)	2816.2 (13.99)		10169.5 (20.57)	64.9 (8.14)	
Others	5044.4 (16.75)	2057.4 (10.22)		7001.3 (14.16)	100.5 (12.6)	
Area						
Seoul capital	15102.4 (50.16)	10943.6 (54.37)	<0.0001	25566.6 (51.71)	479.5 (60.13)	<0.0001
Non-Seoul capital	15,006 (49.84)	9186 (45.63)		23,874 (48.29)	317.9 (39.87)	

* CCI: Charlson comorbidity index.

(adjusted OR, 1.26; 95% CI, 1.20–1.33). For workers with severe disabilities, estimates were not conclusive because the number of women was small, and men and women could not be compared. The risk of disability (adjusted OR in younger workers [< 40 years], 1.69; 95% CI, 1.33–2.14) and the risk of severe disability (adjusted OR in the younger group, [< 40 years], 6.54; 95% CI, 1.53–27.87) were higher in younger workers than in older workers. When stratified by area, workers with disability (adjusted OR in non–Seoul capital area, 1.51; 95% CI, 1.41–1.61) or severe disability (adjusted OR in non–Seoul capital area, 1.88; 95% CI, 1.36–2.60) were at higher risk in nonmetropolitan areas than in metropolitan areas.

Sensitivity analysis produced results similar to those of the main results, except when applied to those who responded with "Decision made by emergency medical personnel" (Supplementary Tables 3 and 4appsec1). Although a difference in the manufacturing industry was evident in the stratification, risks of disability and severe disability in the construction industry were significantly increased, similar to the main result. In the subgroup analysis of manufacturing, risks of disability and severe disability increased significantly among female workers, younger workers (<40 years), and those from the non–Seoul capital area, similar to the main result. Sensitivity analysis (Supplementary Tables 5 and 6appsec1) using treatment period instead of injury severity showed similar results to the main result (Tables 2 and 3). However, some results for severe disability showed insignificant results.

Table 2
Odds ratios (OR) of disability and severe disability according to hospital selection by employer

	Disability		Severe disability	
	Crude OR (95% CI)	Adjusted OR* (95% CI)	Crude OR (95% CI)	Adjusted OR* (95% CI)
Overall	1.12 (1.09–1.16)	1.10 (1.06–1.13)	0.94 (0.80–1.09)	0.84 (0.72–0.99)
Industrial classification				
Construction industry	1.34 (1.28–1.41)	1.26 (1.20–1.32)	1.62 (1.28–2.07)	1.38 (1.08–1.76)
Manufacturing industry	0.95 (0.90–0.99)	0.88 (0.84–0.92)	0.61 (0.49–0.77)	0.54 (0.42–0.68)
Service-related industry	0.83 (0.76–0.91)	0.84 (0.77–0.92)	0.33 (0.15–0.73)	0.29 (0.13–0.64)
Other industry	1.12 (1.01–1.24)	1.03 (0.93–1.15)	0.70 (0.41–1.20)	0.60 (0.35–1.06)

CI: confidence interval.
* adjusted for age, sex, Charlson comorbidity index, injury severity, industrial classification, and workplace size.

Table 3
Odds ratios (OR) of disability and severe disability according to hospital selection by employers in the construction industry

		Hospital selection by others (weighted N, %)	Hospital selection by employer (weighted N, %)	Disability		Severe disability	
				Crude OR (95% CI)	Adjusted OR* (95% CI)	Crude OR (95% CI)	Adjusted OR* (95% CI)
Sex	Male	12763.9 (75.9)	4046.2 (24.1)	1.32 (1.26–1.39)	1.26 (1.20–1.33)	1.65 (1.30–2.11)	1.37 (1.07–1.75)
	Female	395.7 (82.1)	86.5 (17.9)	2.21 (1.71–2.86)	2.40 (1.83–3.15)	NA†	NA†
Age	<40	1385.2 (85.4)	236.2 (14.6)	1.43 (1.14–1.80)	1.69 (1.33–2.14)	3.16 (0.75–13.32)	6.54 (1.53–27.87)
	≥40	11774.3 (75.1)	3896.4 (24.9)	1.31 (1.25–1.38)	1.27 (1.20–1.33)	1.54 (1.20–1.97)	1.32 (1.03–1.69)
Area	Seoul capital area	6309.6 (75.0)	2102.9 (25.0)	1.16 (1.08–1.25)	1.10 (1.02–1.18)	1.19 (0.81–1.75)	0.89 (0.60–1.33)
	Non-Seoul capital area	6850.0 (77.1)	2029.7 (22.9)	1.53 (1.43–1.63)	1.51 (1.41–1.61)	2.06 (1.51–2.82)	1.88 (1.36–2.60)

CI: confidence interval.
* adjusted for age, sex, Charlson comorbidity index, injury severity, industrial classification, and workplace size.
†NA: not available.

4. Discussion

This study identified a relationship between selection of a hospital by employers and the disability suffered by workers involved in an industrial accident using data from the first year (2018) of the PSWCI Second Cohort. In most industries, the selection of a medical institution by the employer was associated with a preventive effect on disability. However, in the construction industry, the risk of both disability and severe disability was significantly higher when the employer selected the medical institution at which a worker involved in an industrial accident was to be treated, although the degree of damage and underlying disease were adjusted. Sensitivity analysis also showed a consistent significant increase in risks of disability and severe disability.

In previous studies, the prognostic factors for the injured patients were age, gender, comorbidity, and preinjury work status. Hospital factors related to prognosis in injured patients were longer intensive care unit stay and repeated nonadherence to transfusion guidelines [26]. On the other hand, appropriate rehabilitation after an acute injury is considered a long-term prognostic factor for the patients [27,28]. Additionally, the selection of an appropriate emergency medical institution through rapid and minimal transport is important for patient prognosis [20]. The hospital selection is generally based on the patient's experience, the recommendation of the primary physician, distance, media reports, and recommendations from people around [29]. It is also determined by the characteristics and severity of the injuries [30]. However, in the absence of guidelines and trained workers, patient evacuation and hospital selection are often made on a case-by-case basis, and these choices are often made at the request of the patient or those around him [30]. Hospital selection by employers, including the designated medical institution, can be affected by the establishment of an emergency medical system and training for emergency situations. In most industries, in our results, the employer had a positive effect on disability if the employer prepared in advance or designated a hospital. Preparations for industrial accidents can produce positive results in the treatment of injured workers [31]. However, in the construction industry, employer-driven hospital selection rather than injured worker-driven selection resulted in poor prognosis. The reasons for this opposite outcome in the construction industry may be attributed to the specific industrial environment of the construction industry. It might be due to the burden of an industrial accident on the employer [32]. When an industrial accident occurs, it is likely to be under supervision by the Ministry of Employment and Labor, which increases the temptation to hide industrial accidents to avoid the consequences of provisions of the "Individual Risk Rating Plan." The plan was designed to prevent industrial accidents by raising insurance premiums with the number of industrial accidents. However, there is a financial incentive for companies to cover up industrial accidents, which can lead to higher industrial accident insurance premiums. However, it is generally considered that this is not a temptation for employers to make inappropriate hospital choices in most industries. Irrational attempts such as inappropriate hospital selection can rather create a negative image of the company and make it a target for intensive monitoring by the Ministry of Employment and Labor. However, in the construction industry, industrial accident reports can have a direct negative impact on contracts because they are reflected in the "prequalification (PQ) for bidding for construction companies" [33]. This is consistent with our finding that hospital selection resulted in significantly increased risk, particularly in the construction industry. Besides, unlike other industries, each workplace in the construction industry is closed when each construction is complete. In other words, even if the construction company does not change, since each construction site maintains for a short period of time and the workers and the environments are constantly changing, it is relatively difficult to systematically prepare the safety management system, including the emergency medical system at each construction workplace [34]. In this situation, the choice, such as the choice of hospital, for the convenience of the employer may be made more easily than the choice for workers. In addition, the construction workplace did not have sufficient education on emergency medical systems in the previous study [35]. The results of the study showed that construction workers lacked an understanding of first aid methods and where and how to send emergency patients. This situation can make choices for workers more difficult due to the lack of information in emergency situations.

In the analysis of the construction industry in this study, there was an interaction showing greater risk among female and younger workers (<40 years of age) and the non–Seoul capital area group for both disability and severe disability. In the construction industry, it can be assumed that women and younger groups will be more affected by hospital choice by the employer due to the relative lack of decision authority as a type of autonomy [36–38]. Because age was an effect modifier in the relationship between decision authority and mental health in a study conducted in the construction industry, age might have to act as an effect modifier in this study [37]. Interactions by gender can be considered a cause of low decision autonomy in women. The Korean construction industry is a male-dominated industry, women hold primarily low-level jobs, and decision autonomy is expected to be low [39,40]. The increase in risk facing non–Seoul capital area workers compared to those from the Seoul capital area can be considered the cause of an imbalance of medical resources among regions in Korea [41,42]. Hospitals in the Seoul capital area have a high average capacity, so the effect on prognosis for injured workers may not be large. Conversely, in the non–Seoul capital area, the average capacity of hospitals is lower, and hospital selection by employers might have a greater impact on the prognosis for injured workers. In addition, the non–Seoul capital area has few hospitals, most of which are small, and the transportation network is relatively poor, making it

difficult to transfer a patient after selecting an inappropriate hospital [43,44]. There is also a lack of long-term rehabilitation medical systems in the non–Seoul capital area [45].

Suggestions regarding how to address the problems associated with hospital selection identified in this study should consider both improvement of emergency medical systems at workplaces and incentives for concealing industrial accidents from insurers. Efforts to reduce cover-ups are particularly important in Korea, where the risk of cover-up is suspected to be high due to the high mortality rate compared with the injury rate [46]. It is recommended that in depth research to improve standards for company-designated hospitals be conducted in the future. If the employer designates a medical institution in advance, and if the employees at the workplace are trained and prepared for industrial accidents with the participation of the medical institution, responses to emergency situations can be improved. However, the selection of a company-designated medical institution without specific criteria, as is now the case, can be abused and lead to cover-ups for industrial accidents. First, it is necessary to consider the distance from the workplace, the types of accidents that might occur in the workplace, and whether the hospital has the capacity to treat the workers. Second, if it is difficult to construct an effective emergency medical system at a workplace, 119 calls (emergency medical services) should be compulsory. In an emergency situation, the initial diagnosis and hospital selection by an emergency medical technician in the prehospital stage can be critical to a patient's prognosis [47]. Third, to reform the emergency medical system, the temptation to conceal industrial accidents should be removed. Prequalification for bidding for construction companies could be revised to include bidding criteria that emphasize death-centered incidents. In the "Individual Risk Rating Plan," no distinction is made according to the size of the workplace, and occupational diseases are excluded. In the future, it is necessary to continuously monitor whether this is a cause of concealment of industrial accidents. If it becomes a problem, reform efforts will be required.

Although only the representative control variables were adjusted, adjustment for unknown risk factors was not performed, which limited the usefulness of our study. This study excluded those who died with a more severe prognosis. In addition, our study used only compensated cases. There is a possibility of selection bias. The injury severity system consisted of only two variables. However, an injury severity system was created by applying the AIS concept and was as detailed as possible. Nevertheless, it should be taken into account that there is a conceptual difference between AIS, which focuses on life-threatening, and disability, which focuses on the loss of work capacity. We performed two sensitivity analyses, as well as the main method. Although the main results were similar, there are differences in some results, so further study is needed under various conditions and research methods. Finally, we tried to explain the mechanism of negative results shown only in the construction industry. Therefore, further research would be needed to validate these explanations. A strength of this study is that it is the first to examine the relationship between employer selection of a medical institution and disabilities in occupational accidents. It is also a case-controlled study with clear temporal precedence. In addition, the Workers' Compensation Insurance Panel Survey, a nationally approved database created by considering the representativeness of workers who have experienced industrial accidents, was used in our study.

5. Conclusions

This study showed that hospital selection by the employer had an effect on the injured workers' prognosis in the construction industry. This is an important issue in terms of worker health and safety. It is necessary to improve emergency medical systems at workplaces and to eliminate incentives for employers to conceal industrial accidents.

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Conflicts of interest

The authors have no conflict of interest to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.shaw.2022.03.011.

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