Journal of The Korea Institute of Building Construction
Vol. 23, No. 6, pp. 875-885 / December, 2023
https://doi.org/10.5345/JKIBC.2023.23.6.875

pISSN 1598-2033
eISSN 2233-5706
www.jkibc.org

Research Paper

Exploring the Triangular Relationship: Occupational Diseases, Work-Related Illness, and Accidents in the Construction Sector

Yi, Kyoo-Jin*

Professor, School of Social Safety System Engineering, Hankyong National University, Anseong, Gyeonggi-do, 17579, Korea

*Corresponding author
Yi, Kyoo-Jin
Tel : 82-31-670-5285
E-mail : helden@hknu.ac.kr

Received : September 11, 2023
Revised : October 15, 2023
Accepted : November 1, 2023

ABSTRACT

This research delves into the evolving interplay between occupational diseases, work-related illnesses, and accidents in the construction industry, focusing on the past twenty years. One significant discovery is the 19-fold escalation in reported occupational diseases, prompting an examination of their root causes and connections to workplace environments. Frequently encountered work-related ailments include physically strenuous tasks, low back pain, and cerebrovascular issues, highlighting the need for robust prevention and management approaches. Predominantly, noise-induced hearing loss and pneumoconiosis are the most common occupational diseases. The study unveils notable correlations between specific work-related illnesses and accidents, indicating the necessity for bespoke safety measures. Additionally, a pronounced association between work-related illnesses and occupational diseases offers insights into underlying risk factors. Remarkably, the findings propose a bidirectional link between occupational diseases and accidents, challenging traditional beliefs about causality. These insights are pivotal for enhancing safety protocols, focusing on preventive measures, and foreseeing occupational diseases that may arise following accidents in the construction industry.

Keywords : construction safety, occupational disease, work-related illness, accident, correlation

1. Introduction

1.1 Research Background

The disease triangle is one of the fundamental principle of the factors involved in disease causation: host, pathogen, and environment[1]. In the construction industry, workers, the host, are aging and working in an environment with a variety of risk factors.

Typical occupational diseases in construction include musculoskeletal disorders, noise-induced hearing loss, and occupational respiratory diseases. Musculoskeletal disorders are injuries to muscles, tendons, joints, and nerves that are caused or aggravated by work. Occupational respiratory diseases are related to exposure to respiratory hazards in tasks such as abrasive blasting, cement pouring, painting, cleaning with organic solvents, and welding.

Unlike manufacturing industry, the construction industry is known to have a high incidence of musculoskeletal disorders. In addition, it is known that the likelihood of developing diseases caused by hazardous factors to which workers are exposed is high in the construction industry. According to Park(2020), more than half of lung cancer cases caused by asbestos, silica, polycyclic aromatic hydrocarbons, and painting occur in construction workers, with welders and waterproofers at high risk[2]. When an accident causes an injury, the after-effects can lead to illness, even after the injury has been treated. Even if

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/4.0/) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Copyright © 2023 The Korea Institute of Building Construction, All rights reserved.

an accident does not occur, work-related or occupational diseases can be triggered by the environmental factors of a construction site.

The construction industry is characterized by relatively higher exposure to occupational diseases than other industries due to the outdoor working environment and repeated contact with hazardous substances. It is difficult to conduct regular work environment measurement or exposure assessment studies at construction sites because the working environment is constantly changing, so it is not meaningful to track hazardous factors in unit tasks and places for specific occupations.

Despite the decline in the number of accidents, the number of cases of some occupational diseases and work-related illnesses has been steadily increasing, raising concerns. Existing studies on diseases in construction sites are either limited to specific occupational diseases or focus on identifying causes and preventing them.

Min suggests that for the assessment of musculoskeletal burden work, it is necessary to measure the psychological load of construction workers rather than measuring the workload of construction workers because there are many dynamic movements in the workplace rather than static movements[3].

To evaluate the effectiveness of a lifestyle intervention for male construction workers at risk of cardiovascular disease in the Netherlands, Groeneveld compared individual counseling face-to-face and by telephone in a randomized controlled trial, and used linear regression analysis to analyze the significant effects of various health-related measures[4].

Kwon argued that at construction sites, workers from dozens of subcontractors often perform a variety of tasks simultaneously, making it difficult to accurately assess exposure not only to direct hazards but also to bystander exposures caused by the surrounding environment[5].

Blanc analyzed data on male employees in the Swedish construction industry to determine the association between rheumatoid arthritis, systemic lupus erythematosus, systemic arthritis, systemic lupus erythematosus, systemic sclerosis, dermatomyositis, and other occupational exposures and diseases associated with silica[6]. Age-adjusted Poisson multivariate regression was used to calculate relative risks to independently predict these diagnoses. The association between occupational silica and various autoimmune diseases was confirmed.

Wada examined differences in stroke and ischemic heart disease mortality by occupation and industry among Japanese professional men aged 25 to 59 years[7]. Using vital statistics data by occupation and industry from the 2010 Japanese Ministry of Health, Labor and Welfare dataset, Wada analyzed and built regression models, and found that occupations and industries with relatively high risk of stroke and ischemic heart disease were service, public administration and management, agriculture and fishing, construction and mining, electricity and gas, transportation, and professional and engineering.

Khahro argued that more deaths among construction workers in Pakistan occur due to poor health rather than safety violations[8]. Based on the premise that health problems of construction workers can cause a lot of problems for projects in terms of time overruns, cost overruns, poor quality, and production losses, various health problems in the construction industry were presented and the causes of these health problems were investigated in depth. The results showed that heat stroke, eye strain, lung irritation, and skin diseases were the most common types of health problems in the construction industry.

Kim analyzed a total of 50 cases of non-musculoskeletal diseases in the construction industry and concluded that it is necessary to develop safety measures for workers[9]. Respiratory diseases, equipment maintenance, and construction sites had the highest number of cases. A number of disease pathogens related to facility maintenance, welding, and construction sites were analyzed, and in the case of facility maintenance, it was found that there were many cases of lung cancer and

pleural malignant mesothelioma caused by asbestos dust, a harmful dust substance.

Min proposed a model to predict possible occupational diseases in advance using CBR and discriminant analysis, and validated each model by applying actual case data of occupational diseases at construction sites[10].

Hwang pointed out the problem that work environment measurement is being conducted at construction sites, but only a few harmful factors are being exposed by categorizing them, such as noise and vibration, which are representative of each process, without conducting work environment measurement, and identified the harmfulness of silicon oxide dust, which is most exposed at construction sites, and developed supplementary improvement measures[11].

Carretero-Gomez examined the relationship between the reporting of accidents by construction workers and the survival probability of firms in a sample of 344 Spanish construction firms in Mallorca from 2004 to 2010[12]. They concluded that the number of accidents has a direct impact on the probability of a firm's survival in the sector.

Jeong focused on the spatialization of tertiary diseases in infectious diseases during the process of spatialization of diseases, examined medical and sociological features, and analyzed the correlation between the spatialization of diseases and the spatial configuration of built-up cities[13].

Although there are many studies on work-related illness and health symptoms among industrial workers, there are not many studies that analyze the relationship between occupational diseases and work-related illness in the construction industry. In addition, there are not many cases of analyzing the relationship between diseases and accidents, because diseases and accidents are usually studied separately. In addition, although there are many studies on accidents, but not many studies attempted correlation analyses between occupational diseases and work-related illness.

1.2 Objective and Methods

The purpose of this study is to analyze the relationship between occupational and work-related illness and accidents, and to identify their interrelationships. This study used KOSIS data on diseases and accidents in the construction industry for the last 20 years[14].

The research methodology of this study is as follows.

First, it analyzes the trend of occupational diseases and work-related illness in construction sites over the past 20 years.

Second, correlation coefficients between work-related illness and accidents, correlation coefficients between work-related illness and occupational diseases, and correlation coefficients between occupational diseases and accidents are obtained through correlation analysis.

Third, derive the triangular relationship between occupational diseases, work-related illness, and accidents based on the correlation coefficients obtained from the correlation analysis.

2. Collection and Analysis of Data

2.1 Data Source

The study utilized data from the Korea Occupational Safety and Health Agency(KOSHA) spanning the past two decades, specifically focusing on diseases and accidents within the construction industry[14]. This dataset provides a comprehensive overview of health and safety incidents within the sector.

2.2 Trends Analysis

The first step in the analysis involved examining the trends in occupational diseases and work-related illness over the 20-year period. This analysis was critical to understanding the scope and scale of health-related issues in the construction industry.

3. Occupational Diseases and Work-related Illness

3.1 Trends in occupational diseases and work-related illness in construction

Looking at the trend of occupational diseases and work-related illness in construction sites over the past 20 years, the number of occupational diseases increased 19 times from 43 cases in 2001 to 831 cases in 2021(Figure 1). For work-related illness, the number of reported cases increased from 286 in 2001 to 2,224 in 2021, a 7.8-fold increase. This increase may be due to a change in awareness of occupational diseases rather than an increase in the number of cases of occupational diseases and work-related illness, but it is true that the number has increased significantly.

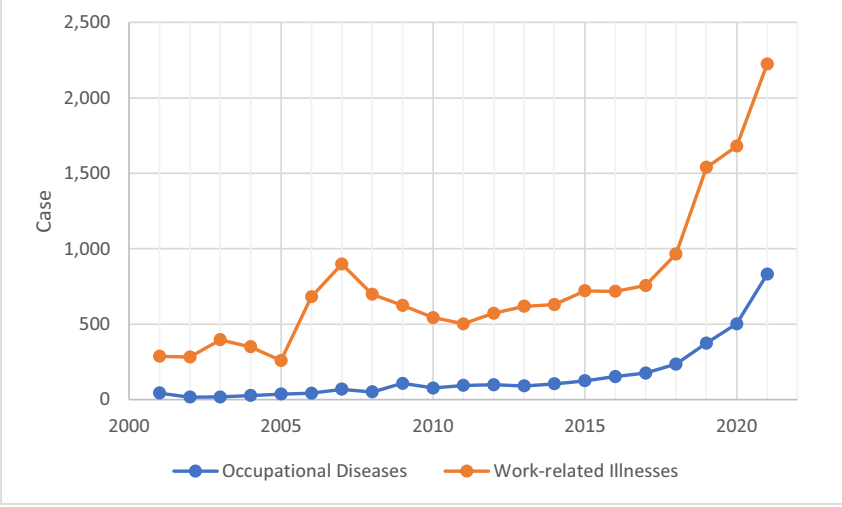

Figure 1. Trends in occupational diseases and work-related illness in construction

Regarding work-related illness, the most reported cases are physically demanding work, followed by low back pain and cerebrovascular diseases(Figure 2).

When comparing the number of reported cases of accidental low back pain between 2006 and 2021, there is no significant change from 377 to 335, but a significant increase from 31 to 397 for non-accidental low back pain(Figure 3). This may be due to a change in the perception of low back pain, from only recognizing those directly related to accidents to recognizing non-accidental low back pain as a work-related disease. On the other hand, cerebrovascular diseases show a decreasing trend from 235 cases in 2001 to 137 cases in 2021.

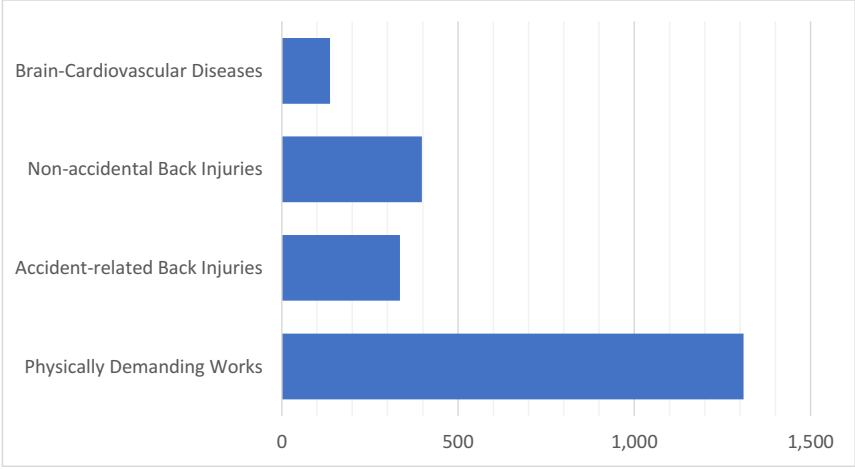

Figure 2. Principal work-related illnesses in 2021

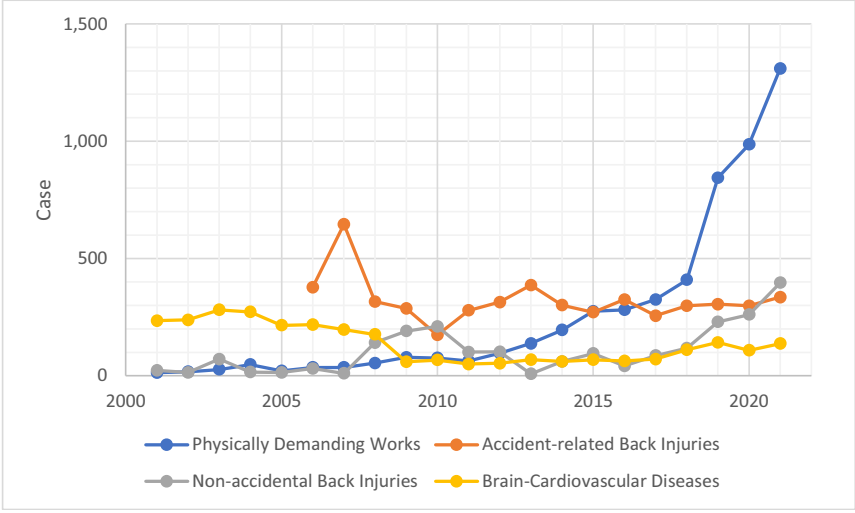

Figure 3. Progression of work-related illnesses over time

In terms of occupational diseases, noise-induced hearing loss is the most commonly reported, followed by pneumoconiosis, asbestosis, occupational cancer, and infectious diseases(Figure 4). The largest increase in occupational diseases over the past 20 years has been in pneumoconiosis, with only two cases reported in 2001 and 228 cases in 2021, a 114-fold increase. Noise-induced hearing loss has also increased significantly, from only 9 cases in 2001 to 468 cases in 2021, a more than 50-fold increase. Infectious diseases, on the other hand, have not shown a consistent trend. In 2020, the start of the coronavirus pandemic, there was only one case of infectious disease, and in 2021 there were 21 cases, far fewer than the 55 cases reported in 2009 during the swine flu pandemic(Figure 5).

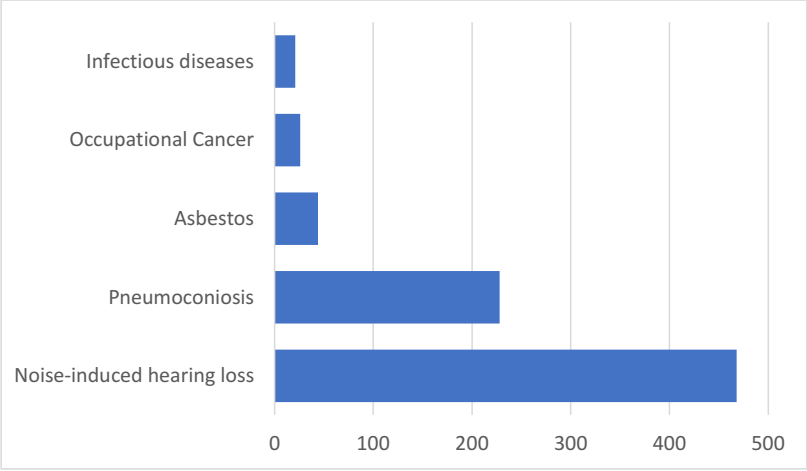

Figure 4. Predominant occupational disease in 2021

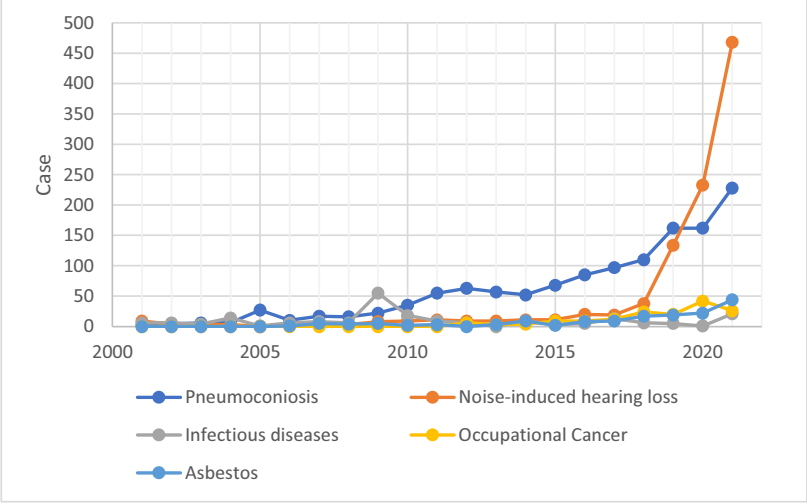

Figure 5. Trends in the prevalence of occupational diseases

4. Correlation analysis

In this study, the Pearson correlation coefficient was obtained to analyze the correlation. Pearson correlation coefficient is a statistical measure that quantifies the strength and direction of a linear relationship between two continuous variables. The Pearson correlation coefficient is obtained by the equation 1(the closer it is to 1.0, the higher the correlation). This method is commonly used because they are easy to interpret, effective in identifying linear relationships, and easy to compare between correlations, and is considered appropriate for this study.

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - \sum y)^2)}} \tag{1}$$

where x represents one of the variables and y represents the other variable.

To determine the correlation between work-related illnesses and accidents, correlation coefficients were calculated and the results are shown in Table 1. The strongest correlation was between falling and heavy work, with a correlation coefficient of 0.78, followed by cerebrovascular disease and electric shock, 0.77, cerebrovascular disease and workplace traffic accidents, 0.77, heavy work and contact with objects at abnormal temperatures, 0.75, heavy work and cuts, cuts, and stab wounds, 0.72, accidental low back pain and explosions and ruptures, 0.71, and non-accidental low back pain and falls, 0.70. Standard error ranges from 0.14 to 0.20.

There is no logical association between illnesses and accidents, but it is possible that there are simple coincidences or unidentified associations.

Table 1. Analysis of the correlation between work-related illnesses and accidents

	Physically Demanding Works	Accident-related Back Injuries	Non-accidental Back Injuries	Brain-Cardiovascular Diseases
Slip/fall	0.78		0.70	
Cut/slash/stab	0.71		0.62	
Electrocution				0.77
Explosion/Burst		0.71		0.69
Abnormal Temperature Object Contact	0.75		0.64	
Unbalanced and unreasonable behavior	0.63			
Workplace Traffic Accidents		0.52		0.77
Violent behavior			0.63	
Bumping		0.52		

The results of the correlation analysis between work-related illness and occupational diseases are shown in Table 2. The largest correlation was between pneumoconiosis and heavy workload, with a correlation coefficient of 0.96, followed by asbestos and heavy workload, 0.95, noise-induced hearing loss and heavy workload, 0.93, occupational cancer and heavy workload, 0.89, other organic chemicals and carpal tunnel syndrome, 0. 88, asbestos and carpal tunnel syndrome 0.88, cadmium and physical work 0.87, noise-induced hearing loss and physical work 0.86, other organic chemicals and physical work 0.86, pneumoconiosis and mental illness 0.85, and asbestos and mental illness 0.84. Standard error ranges from 0.14 to 0.20.

Table 2. Examination of the relationship between work-related illnesses and occupational diseases

	Physically Demanding Works	Non-accidental Back Injuries	Accident-related Back Injuries	Carpal Tunnel Syndrome	Mental illness
Pneumoconiosis	0.96	0.77		0.82	0.85
Noise-induced hearing loss	0.93	0.82		0.86	0.69
Anomalies	0.63				0.53
Physical factors	0.59				0.79
Other Organic Compounds	0.86	0.83		0.88	0.78
Asbestos	0.95	0.81		0.88	0.84
Cadmium	0.87	0.73		0.61	0.57
Occupational Skin Disease	0.54	0.77		0.62	
Occupational Cancer	0.89	0.66		0.63	0.80

Some of the logical associations between work-related illness and occupational diseases do not appear to be connected, but it is possible that there are unidentified associations.

Table 3 shows the results of the correlation analysis between occupational diseases and accidents. The strongest correlation was between pneumoconiosis and cuts, cuts, and stabbings, with a correlation coefficient of 0.84, followed by pneumoconiosis and contact with hot objects, 0.83, asbestos and falls, 0.77, occupational cancer and contact with hot objects, 0.77, pneumoconiosis and falls, 0.76, and asbestos and contact with hot objects, 0.73. Standard error ranges from 0.12 to 0.20.

Rather than accidents being the cause of occupational diseases, there seems to be a reciprocal effect, i.e., it is possible that accidents can be caused by occupational diseases.

Table 3. Analysis of the connection between occupational diseases and accidents

	Falls from heights	Slip/fall	Cut/slash/stab	Abnormal Temperature Object Contact	Unbalanced and unreasonable behavior	Chemical Spills-Contact	Violent behavior
Pneumoconiosis	0.70	0.76	0.84	0.83	0.62	0.67	0.63
Noise-induced hearing loss		0.69	0.51	0.62	0.55		
Anomalies	0.54	0.54	0.60	0.51			
Physical factors	0.55	0.54	0.58	0.62		0.66	
Other Organic Compounds		0.69	0.59	0.72	0.54		0.55
Asbestos	0.53	0.77	0.67	0.73	0.55	0.52	0.54
Occupational Cancer	0.62	0.73	0.73	0.77	0.60	0.62	

5. Discussion of the relationship between illness and accidents

5.1 Increase in Occupational Diseases

In this study, a correlation analysis was conducted using data on diseases and accidents in the construction industry over the past 20 years to identify the interrelation between occupational diseases, work-related illness, and accidents in the construction industry, and the following conclusions were drawn.

The number of occupational diseases on construction sites has increased 19-fold over the past 20 years. In terms of work-related illnesses, the most frequently reported cases are physically demanding work, followed by low back pain and cerebrovascular disease. In terms of occupational diseases, noise-induced hearing loss is the most commonly reported, followed by pneumoconiosis, asbestosis, occupational cancer, and infectious diseases.

The largest increase in occupational diseases over the past 20 years has been pneumoconiosis, which has increased 114 times. Noise-induced hearing loss has also increased significantly, with a more than 50-fold increase. The strongest correlation between work-related illness and accidents is fall accidents and heavy work, followed by cerebrovascular disease and electric shock, cerebrovascular disease and workplace traffic accidents, and heavy work and contact with objects with abnormal temperatures.

5.2 Common Work-related illness and Prevalent Occupational Diseases

Work-related illness most frequently reported in the construction industry include physically demanding work, low back pain, and cerebrovascular diseases. Among occupational diseases, noise-induced hearing loss is the most commonly reported, followed by pneumoconiosis, asbestosis, occupational cancer, and infectious diseases. Significant Increases in Specific Diseases: Pneumoconiosis has experienced a staggering 114-fold increase in cases, while noise-induced hearing loss has increased over 50-fold. However, infectious diseases showed no consistent trend.

5.3 Reciprocal Effect

When analyzing the correlation between work-related illness and occupational diseases, the largest correlation was between pneumoconiosis and physical work, followed by asbestos and physical work, noise-induced hearing loss and physical work, and occupational cancer and physical work.

When analyzing the correlation between occupational diseases and accidents, the largest correlation was between pneumoconiosis and cuts, cuts, and stabbings, followed by pneumoconiosis and contact with objects with abnormal temperatures, asbestos and falls, and occupational cancer and contact with objects with abnormal temperatures.

The relationship between illnesses and accidents, and between work-related illnesses and occupational diseases, may be due to unidentified associations. Rather than accidents causing occupational diseases, there seems to be a reciprocal effect, and it is possible that occupational diseases can cause accidents.

The study found notable correlations between specific work-related illness and accidents, such as falls and heavy work, cerebrovascular disease and electric shock, and heavy work and contact with objects at abnormal temperatures. Strong correlations were observed between pneumoconiosis and heavy workload, asbestos and heavy workload, noise-induced hearing loss and heavy workload, occupational cancer and heavy workload, among others. The research highlighted correlations between pneumoconiosis and cuts, cuts, and stabbings, asbestos and falls, and occupational cancer and contact with hot objects.

Instead of accidents causing occupational diseases, the study suggests a reciprocal relationship, implying that occupational diseases may contribute to accidents. In conclusion, this study sheds light on the complex web of relationships between occupational diseases, work-related illness, and accidents in the construction industry. The increasing incidence of certain diseases and the identified correlations provide valuable insights for enhancing safety practices and promoting worker health in this high-risk sector.

6. Conclusions

This article explores the relationship between occupational diseases, work-related illness, and accidents in the construction industry using data spanning the past two decades. The study's findings have several implications for improving safety practices and health management in the construction industry.

Prevention and Management: Understanding the correlation between specific work-related illnesses and accidents allows for more targeted safety interventions. This knowledge can inform prevention and management strategies to reduce the

incidence of these illnesses and accidents.

Predictive Insights: Recognizing the reciprocal relationship between occupational diseases and accidents enables the prediction of post-accident occupational diseases. This predictive capability can help in early intervention and treatment planning for affected workers.

Safety Prioritization: The study emphasizes the need to prioritize safety measures that address both occupational diseases and accidents. This holistic approach can enhance safety practices and reduce the overall health risks faced by construction workers.

In summary, this research offers a comprehensive analysis of the data collected from the construction industry over two decades. By revealing the intricate relationships between occupational diseases, work-related illnesses, and accidents, the study provides valuable insights to inform safety practices, prioritize prevention efforts, and predict health outcomes in the construction sector.

Funding

Not applicable.

ORCID

Kyoo-Jin Yi, https://orcid.org/0000-0002-7520-0045

References

1. Francl LJ. The disease triangle: a plant pathological paradigm revisited. ND: North Dakota State University; 2001. https://doi.org/10.1094/PHI-T-2001-0517-01
2. Park HH, Kim SD, Kim SH, Park SH. A study of exposure hazards, doses, and fractions by occupation in the construction industry [Internet]. Ulsan (Korea): Occupational Safety and Health Research Institute. 2020 Nov 30. Available from: https://kosha.or.kr/oshri/publication/researchReportSearch.do?mode=download&articleNo=419716&attachNo=237099
3. Min SN. Comparing the results of analyzing musculoskeletal strain tasks among construction workers using different risk assessment methods. The Safety Technology. 2005 Jan;95:16-21.
4. Groeneveld IF, Proper KI, Beek AJ, Mechelen W. Sustained body weight reduction by an individual-based lifestyle intervention for workers in the construction industry at risk for cardiovascular disease: Results of a randomized controlled trial. Preventive Medicine . 2010 Sep-Oct ;51(3-4):240-6. https://doi.org/10.1016/j.ypmed.2010.07.021
5. Kwon YJ. Occupational diseases of construction industry. Hanyang medical reviews. 2010 Nov;30(4):290-5. https://doi.org/10.7599/hmr.2010.30.4.290
6. Blanc PD, Jarvholm B, Toren K. Prospective risk of rheumatologic disease associated with occupational exposure in a cohort of male construction workers. The American Journal of Medicine. 2015 May 22;128(10):1094-101. https://doi.org/10.1016/j.amjmed.2015.05.001
7. Wadaa K, Eguchi H, Prieto-Merino D. Differences in stroke and ischemic heart disease mortality by occupation and industry among Japanese working-aged men. SSM - Population Health. 2016 Dec;2:745-9. https://doi.org/10.1016/j.ssmph.2016.10.004

8. Khahro SH, Ali TH, Talpur AH, Akhund MA. Occupational health problems in construction industry: A case study. Sindh university research journal. 2016 Dec;48(4):737-40.
9. Kim JH. Priority Management for Disease Prevention through the Analysis of Harmful Factor and Causation of Occupational Disease in Construction Industry. Journal of AIK. 2016 Oct;18(5):197-204.
10. Min YE, Cho SJ, Ji HJ, Yoo WS, Shin YS. Predicting model for occupational disease using complex analysis in construction site. Korea science & art forum. 2018 Dec;36:109-20. https://doi.org/10.17548/ksaf.2018.12.30.109
11. Hwang JS. A study on the harmfulness of silicon oxide dust and measures for the work environment improvement in construction sites. Journal of the Society of Disaster Information. 2022 Sep;18(3):478-86. https://doi.org/10.15683/kosdi.2022.9.30.478
12. Carretero-Gomez JM, Forteza FJ, Estudillo B. Linking occupational accidents and construction firm survival. Journal of Safety Research. 2023 Jun;85:485-91. https://doi.org/10.1016/j.jsr.2023.05.002
13. Jeong TJ. The study on the spatial configuration and relationship in COVID-19 pandemic barrier space. Journal of the Korean Institute of Culture Architecture. 2021 May;74:127-34.
14. Occupational Illness Incidence by Disease Type [Internet]. Daejeon (Korea): Korean Statistical Information Service. C2001-2021 [cited 2023 Jun 27]. Available from: https://kosis.kr/statHtml/statHtml.do?orgId=118&tblId=DT_11806_N038&conn_path=I3