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Investigating the causes of accidents, safety behaviour and injuries in three regions in China

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Professional paper

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The construction industry has a higher rate of occupational accidents at construction sites than other sectors. Therefore, it is necessary to take effective measures to prevent accidents from occurring on the construction site. This study examines the attitudes of construction staff towards construction safety, the sources of their safety knowledge, and their views on the likelihood of accident occurrence. It identifies the causes of accidents and the most common types of injuries at construction sites, focusing on three specific regions in China: Shanghai, Qinghai, and Henan. Data were collected using questionnaires. Overall, the results show that the main reasons for occupational accidents are workers' lack of safety awareness (over 90%), work fatigue, and the older age of staff, all of which contribute to unsafe behaviour at the construction site.

Key words:

occupational accidents, injuries, construction sites, SPSS, Shanghai, Qinghai, Henan

Stručni rad

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Istraživanje uzroka nesreća, sigurnosnog ponašanja i ozljeda u trima kineskim pokrajinama

Građevinska industrija bilježi višu stopu ozljeda na radu na gradilištima u usporedbi s ostalim industrijama. Zato je neophodno provoditi učinkovite mjere za sprječavanje nastanka nesreća na gradilištima. U ovom se istraživanju analiziraju stavovi građevinskih radnika i inženjerskog osoblja o zaštiti na radu u graditeljstvu, izvori njihova znanja o zaštiti na radu te njihova percepcija vjerojatnosti nastanka nesreća. U radu utvrđuju se uzroci nastanka nesreća te najčešće vrste ozljeda na gradilištima, s težištem na trima specifičnim pokrajinama u Kini: Šangaju, Qinghaju i Henanu. Podaci su prikupljeni pomoću upitnika. Općenito, rezultati pokazuju da su glavni uzroci nesreća na radu nedovoljna razina svijesti radnika o sigurnosti (više od 90%), radni zamor te starija dob zaposlenika, pri čemu svi navedeni čimbenici pridonose pojavama nesigurnog ponašanja na gradilištu.

Ključne riječi:

nesreća na radu, ozljede, gradilišta, SPSS, Šangaj, Qinghai, Henan

1. Introduction

Currently, China leads the world in the number of building projects [1]. The construction industry is a major contributor to the gross national product in the Chinese economy, providing numerous employment opportunities for labour [1, 2]. On the other hand, the construction industry is prone to a higher rate of occupational accidents and injuries than other sectors [3]. With the rise in construction projects, the number of construction accidents has increased [4]. Although safety measures are implemented during construction, the incidence of occupational accidents in the industry has not shown significant improvement [5]. In the USA, around 20 % of worker fatalities occurred in the construction industry in 2019, according to the Occupational Safety and Health Administration, making it one of the most hazardous industries [6]. Further, the most common cause of fatalities in the construction industry in the USA is a fall from height [6]. Similarly, more than one-fifth of the overall fatalities in 2019 in the EU were in the construction industry [3]. In Spain, a total of 40,582 occupational accidents with serious consequences were recorded in the construction industry over the 20-year period from 2003 to 2022 [63]. China recorded 734 accidents and 840 fatalities in the construction industry in 2018, according to the Ministry of Housing and Urban–Rural Development of the People’s Republic of China [7]. There is an increasing trend from 2011 to 2017 in the total number of occupational accidents in Hong Kong, with the number of accidents with injuries increasing each year significantly, and the mortality rate was 18.5 in 2017 [8]. Overall, 41 % of industrial accidents in 2024 in Hong Kong were related to the construction industry, according to the report from the Labour Department of Occupational Safety and Health Branch [9]. For the similar period from 2011 to 2015, the number of occupational injuries and fatal injuries in Korea first increased till 2013 and started decreasing from 2014 [10]. The high rates of accidents and mortality in the construction industry are widespread across different countries and regions worldwide.

Because building projects include large-scale, high-investment projects, occupational accidents can have serious consequences and losses after they occur [11]. In addition to economic losses, occupational accidents can result in casualties, affecting social stability and development [12]. Overall, the impact of occupational accidents on the construction industry has recently gained a deeper influence than on the project itself. It influences society; hence, it has become a concern for the government [13]. Construction safety has attracted significant attention in society, and it is now focusing directly on workers’ lives and property safety [14]. For Contractor companies, it is essential to implement safety measures to manage all aspects of construction sites, reduce risks, and prevent accidents. The goal of contractor and subcontractor

enterprises is to achieve a zero-accident rate as much as possible [15].

Owing to the current safety situation in the construction industry, this study aims to investigate the causes of safety accidents, safety behaviours, sources of training and learning of safety procedures, and types of injuries that occur at construction sites, focusing on three particular regions in China: Shanghai City, Qinghai Province, and Henan Province. The research questions addressed were as follows:

- What are the most common sources and effective methods of learning about safety at construction sites?
- What are the most common causes of unsafe behaviour and occupational accidents at construction sites in Shanghai City, Qinghai and Henan Provinces?
- What are the most common injuries caused by occupational accidents on construction sites?

To address the RQs, a quantitative methodology was used in this research. A questionnaire survey was conducted to collect data from the three regions. For a quantitative analysis, statistical analysis with the aid of SPSS and Cronbach’s alpha reliability test are selected as suitable tools.

To limit occupational accidents and injuries during construction projects and lay a foundation for accident prevention, this study examines current safety practices in these three regions and offers recommendations to improve them and prevent occupational accidents. Furthermore, this study lays the foundation for managing and preventing accidents in the construction sector. Some of the most challenging and complex building and infrastructure projects are planned for completion in Shanghai, making it and Beijing two leading cities in China’s global construction facilities [62]. Hence, safety practices in large and complex projects play an important role.

2. Literature review

An occupational accident is an unexpected event or series of events that results in physical injury to a person at work [16]. Injuries are any damage to the body caused by energy transfer during working hours, with a short time lag between exposure and the health event. At construction sites, most workers have low levels of education, weak safety awareness, and no foresight of potential safety problems [17]. Construction operators lack pre-employment safety education and training, or fail to meet national standards after training; yet they continue to work. In addition, most studies lacked the theoretical knowledge required for construction site safety. During the construction process, they do not understand some safety measures and technical regulations, leading to improper construction practices such as improper formwork folding, prohibited lifting of tower cranes, and other illegal

activities. In the event of an emergency, it is not possible to respond flexibly or solve problems, thereby increasing the invisible threat to the safety of the construction industry in China [18].

By consulting the literature on occupational accidents in construction and safety measures, the types of occupational accidents and the corresponding injuries that may occur at construction sites are listed in this section to provide literature support for subsequent investigation and research. The list of occupational accidents that occurred at building sites and construction projects is presented in Table 1.

Table 1. List of occupational accidents in construction

Type of accident	Source
Fall from height	[6, 8-10, 17-24, 27]
Slip, trip or fall on the same level	[8, 9, 19, 21, 22]
Contact with electricity (electric shock)	[3, 8-10, 18, 19, 22, 24, 27]
Striking against a fixed or stationary object	[8, 9, 19, 27]
Struck by a moving object	[3, 8-10, 19, 22, 27]
Struck by falling objects (equipment, tools...)	[8-10, 18, 19, 27]
Trapped between objects	[8, 9, 19]
Injured by lifting or carrying	[9, 18, 19, 22]
Exposure to a fire accident	[9, 10, 18, 19, 22, 24]
Exposure to an explosion	[9, 10, 18, 19, 22, 27]
Ground collapse	[18, 19, 25]
Use of heavy machinery	[18, 19, 24, 26, 27]

For searching for potential accidents in the construction industry, the keywords such as "construction accidents", "occupational accident in the construction industry", and "occupational accidents on the construction sites" are entered into Scopus and Web of Science, and screen relevant literature, excluding types of resources other than academic journals. The abstracts of selected articles were reviewed to identify literature that met the objectives. Finally, the types of construction accidents were compiled into a list, along with references for each type. The most common occupational accident in construction is a fall from a height, as reported in countries including the USA, Hong Kong, Korea, Turkey, Cyprus, and Spain [6, 8, 10, 20, 21, 63]. The causes of falls from heights include scaffolding, ladders, roofs, floor openings, structures, or inadequate personal protective equipment (PPE) [6].

To compile a list of injury types in the construction industry, the keywords "construction injury", "occupational injuries in the construction industry", and "construction accidents and

injuries" are used to screen scholarly websites and identify academic journals. Then, a review of the abstract and screening of the article's content checks whether the article meets the criteria. In conclusion, the documented accident injuries were compiled into a list with corresponding references, presented in Table 2.

Table 2. List of injuries sustained during construction

Type of injuries	Source
Fracture	[22, 27]
Electric shock	[22, 27, 28, 29]
Burns	[22, 27, 28]
Amputation	[22, 27]
Cut/tear	[10, 22, 28]
Glass or dust in the eye	[22, 27]
Wounds	[22, 27]
Bleeding	[22, 27]
Suffocation	[27]
Puncture from steel bars	[30]
Concussion	[29]
Fainting/Coma	[22, 27]

In construction, several scholars have applied statistical analysis to reduce accident frequency and raise safety management standards. Chen et al. [31] improved the statistical index system for construction safety and accidents in China. Wang et al. [32] provided statistics on accidents in the Chinese construction industry between 2003 and 2016. Furthermore, Li et al. [33] studied the relationship between accident type and season in the Chinese construction industry during the first half of 2007 to 2017. These studies provide a basis for decision-making regarding safety measures in the construction industry. Currently, the safety situation in the construction sector in China remains severe, and further accident analyses are needed to identify accident causes from multiple perspectives and to develop corresponding safety countermeasures.

3. Methodology

This study begins with two aspects of safety measures and accidents on construction sites. It uses a literature review to compile an accident list and an injury type list, designs a questionnaire for data collection, and uses SPSS for statistical analysis, so readers can more intuitively understand the types and causes of accidents in construction projects. Implementation of the results is of great importance for construction site safety management and for improving the safety of construction projects.

3.1. Questionnaire survey

The questionnaire was designed to collect data from construction site staff. This questionnaire consists of the following parts:

- background of the participants (age, working experience, job position, and educational background)
- type of construction or infrastructure project on which they are working currently
- attitude of construction personnel towards construction site safety management and causes of unsafe behaviours;
- probability of different occupational accidents at the construction site
- type of accident injuries
- causes of safety accidents at the construction site.

The first part of the questionnaire addressed the background of the participants (construction site staff), including age, work experience, job position, education level, and the types of construction or infrastructure projects they had been engaged in.

3.2. Data analysis using SPSS

The questionnaire was divided into two dimensions: the first assessed the attitudes of construction workers towards safety management at construction sites, while the second focused on occupational accidents that occur at construction sites and their consequences. This study employed a quantitative research method. Statistical analyses were conducted on the respondents' age, work experience, job position, educational background, and project type. Other data from the questionnaire were processed using *SPSS v. 25*. SPSS is a reliable software for the statistical analysis of data [34]. Data analysis was performed based on the software's calculation results.

4. Results and discussions

4.1. Participant's background

A total of 58 questionnaires were collected from the construction site staff. Construction site staff include construction workers, technicians, machine operators, engineers, and site managers. All construction site staff were included in this survey because they were working on the site and were exposed to potential hazards, regardless of their position. However, such construction sites are potentially dangerous. Regardless of their position, construction workers, operatives, technicians, and engineers are equally exposed to hazards [64]. In addition to construction workers, all parties on the site should be aware of and understand safety.

Data were collected from three regions of China: Shanghai City, Qinghai Province, and Henan Province. The questionnaire survey met the quantitative requirements

for data analysis and provided reliable data and reference values. Figure 1 shows the age distribution of the construction personnel at the site. More than 50 % of the staff were between 21 and 30 years old, representing the largest group in this study. Approximately 22 % of the staff members were between 31 and 40 years old. However, 17 % of the staff were aged 41-50 years. The minor group comprised 1.72 % of the staff who were older than 61 years. The majority of staff members are between 21 and 30 years old, resulting in most of them (approximately 55 %, see Figure 2) having less than 10 years of work experience. The second-largest group comprised staff with 10-15 years of work experience. Less than 7 % of the staff had 16-20 years of work experience. More than 3 % of the staff had over 30 years of work experience.

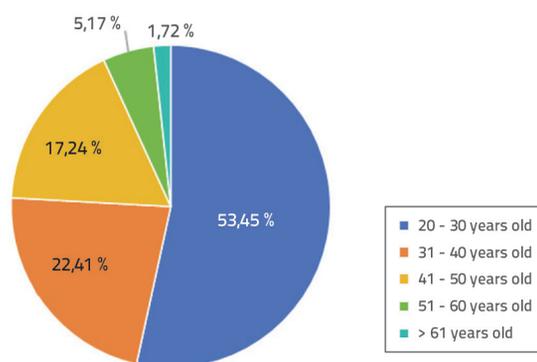


Figure 1. The age of the respondents

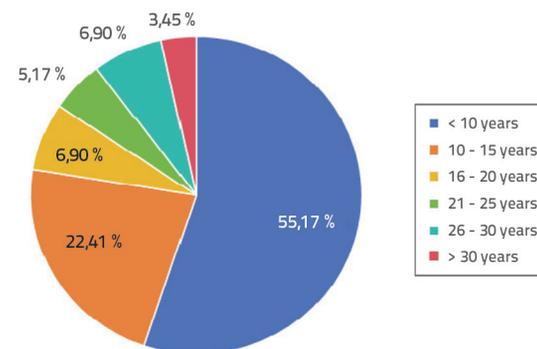


Figure 2. Working experience

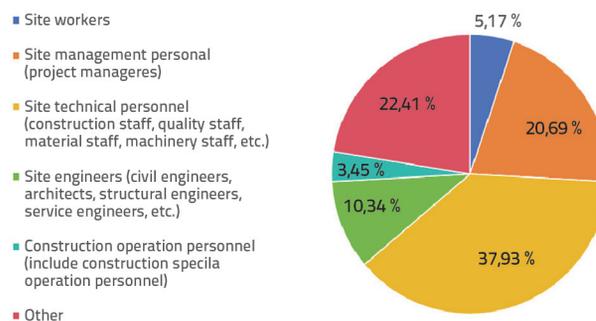


Figure 3. Job position

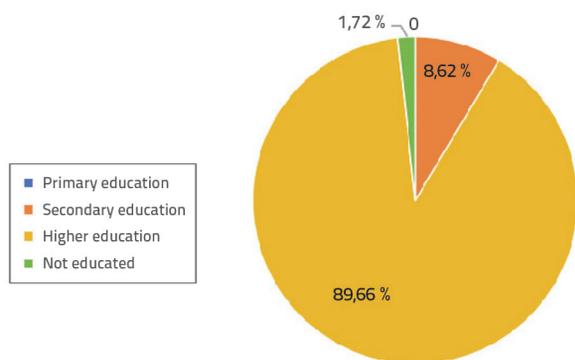


Figure 4. Educational background

Figure 3 shows the participants’ job positions. More than one-third of the participants worked as site technical personnel, such as construction, quality, or machinery personnel. Technical personnel at the site are responsible for the technical details of the construction sites, such as the construction process, quality of materials and work, and machinery details. Approximately 20 % of the staff are site management personnel. More than 10 % of the staff are site engineers. Construction personnel are responsible for the operational processes at the site. The other staff members were related to the staff working on the construction site, and their positions were not included in the previous positions. Figure 4 illustrates the educational backgrounds of the employees. Approximately 90 % of the personnel had a higher level of education. On the other hand, 8.62 % of the participants had secondary education. Table 3 provides insights into the types of construction projects in which workers are currently working. According to the data, the majority were high-rise buildings (more than 50 %), followed by multistory buildings (approximately 25 %). In total, 77 % of the construction projects were buildings. Less than 10 % of these projects are infrastructure projects.

Table 3. Types of construction and infrastructure projects

Projects	Percentage [%]
High-rise building	53.45
Multi-storey buildings	24.14
Roadways	1.72
Railways	3.45
Bridges	1.72
Tunnels	1.72
Other	13.79

4.2. Questionnaire reliability

Questionnaires are the most widely used survey tools in construction management [35]. Whether the questionnaire design meets the requirements and achieves its intended purpose must be evaluated by assessing its reliability and validity [36]. The questionnaire’s reliability indicated the consistency

and stability of the measurement results obtained through repeated measurements of the same survey object under the same conditions. Reliability is an index that reflects the degree to which measurement results are affected by measurement errors. The Cronbach’s α coefficient is widely used in reliability analysis [37] and is also applied in this study. The results of the Cronbach’s α coefficient are provided in Table 4. If the Cronbach’s alpha coefficient is greater than 0.9, the reliability is considered high; if it is between 0.9 and 0.8, the reliability is relatively high. However, if the Cronbach’s alpha coefficient is less than 0.7, the reliability is low, and the questionnaire should be redesigned [38]. According to Table 4, the reliability indices of Dimensions I and II, as well as the overall questionnaire, were considered high.

Table 4. Measurements of reliability analysis

Dimension	Questions	Cronbach’s Alpha
Dimension I	Q 6 – 11	0.821
Dimension II	Q 15 – 32	0.968
Overall questionnaire		0.954

4.3. Results analysis of dimension I

In dimension I, this study conducted statistical analyses of the sources and channels of construction safety knowledge (Figure 5), effective safety education methods (Figure 6), and reasons for unsafe behaviours of operators after safety education and training for different survey objects (Figure 7).

Questions 5–7 in the questionnaire, which address sources and channels of safety knowledge, the effectiveness of construction safety education models, and the causes of unsafe behaviour, are multiple-choice questions that allow multiple answers per question. If there are no items on the list, they can also add additional sources of safety knowledge. The percentage was calculated by dividing the number of participants who selected the item by the total number of participants.

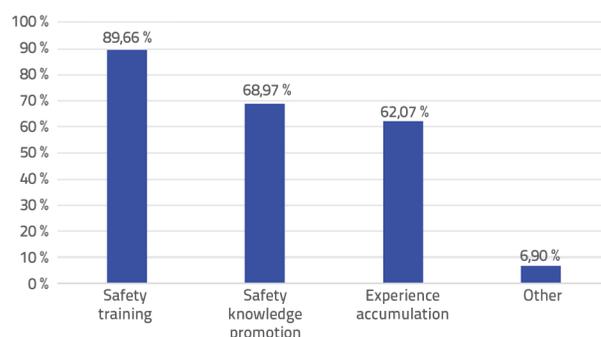


Figure 5. Sources of construction safety knowledge

Figure 5 shows that safety knowledge among construction personnel primarily originates from safety training within the construction unit, followed by publicity and experience

accumulation. Safety education and training for construction workers are key to improving construction safety management. This can simultaneously enhance the safety awareness of construction personnel. Strengthening safety education and training can significantly reduce the safety management costs of construction enterprises and improve site safety. Therefore, construction enterprises should pay attention to the safety education and training of construction project practitioners.

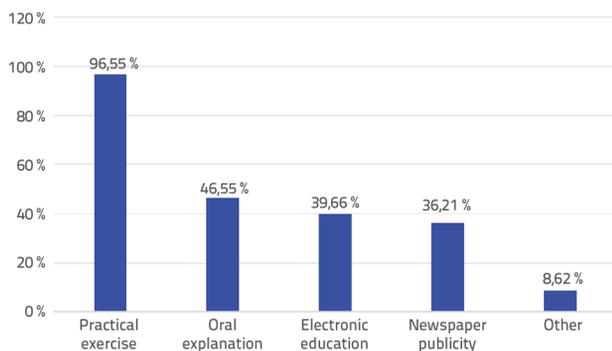


Figure 6. Effectiveness of construction safety education methods

Figure 6 depicts the methods used for construction safety education, with respondents reporting that practical exercises were the most effective. Oral explanations, electronic education, and newspaper publicity followed this. Through field demonstrations, construction personnel can understand the safety hazards that occur at construction sites, learn how to prevent accidents, and provide emergency treatment. During the demonstration process, the actual situation is simulated, and construction personnel can participate personally, which combines theoretical knowledge with practical operations, enhances their self-protection awareness and level, and increases their learning interest and participation [39]. With advances in technology and AI, the means of safety education and training have modernised. During safety education and training programs, explanations can help construction personnel better understand safety measures and deepen their understanding of the learning content [40]. Newspaper propaganda is a method of safety education and training that involves hanging safety banners, slogans, and signs to promote safety. Construction enterprises should focus on operator safety education, enrich their content and forms, and improve the effectiveness of safety training [41].

Work fatigue and older age were the most common causes of unsafe operator behaviours, as illustrated in Figure 7. Furthermore, it is followed by a lack of knowledge and skills, meeting deadlines, relevant regulations and procedures, and safety awareness. Usually, unsafe behaviour among employees with less work experience stems from a lack of knowledge and skills. On the other hand, personnel with extensive work experience are older, and their causes of unsafe

behaviour are work fatigue and age. During construction, some operational procedures are complex; hence, some technicians often regard safe operating methods as redundant and turn a blind eye to them and safety precautions for convenience [42, 43]. After long working hours, the ability of construction personnel is reduced due to fatigue [44, 45]. This can result in physical and psychological fatigue. Physical fatigue manifests as muscle fatigue from high-intensity or long-term physical labour, as well as muscle soreness. These effects slow the operation speed, coordination, and flexibility of the movement, thereby reducing accuracy. With decreased work efficiency, human error increases, which can lead to accidents. Mental fatigue manifests as reduced thinking ability, distracted attention, chaotic work, and poor efficiency. Therefore, the recommendation for the construction unit is to address the above reasons for unsafe behaviour, increase investment in construction safety education and management, and improve worker safety.

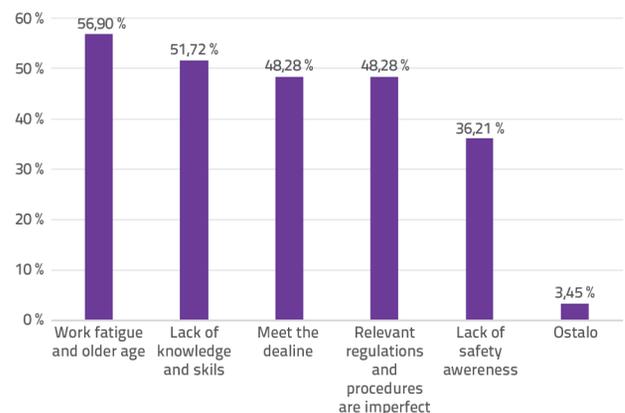


Figure 7. Causes of unsafe operator behaviour

4.4. Result analysis of dimension II

In Dimension II, the ages of the parties involved in the construction accident during their working lives (Figure 8), the types of injuries that occurred at the construction site (Figure 9), and the causes of the accidents (Figure 10) were considered.

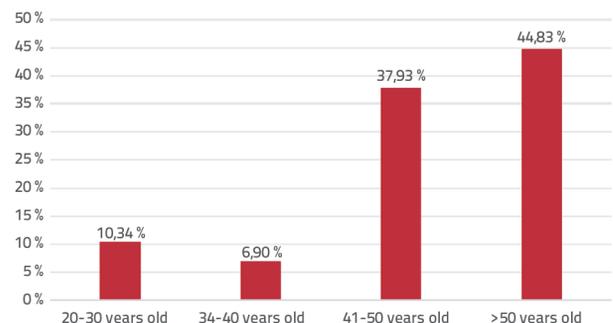


Figure 8. Age of parties involved in construction accidents

The results in Figure 8 show that the majority of parties involved in construction site accidents are generally older than 50. Approximately 44.83 % of workers aged 50 or older had experienced accidents. In the second position, 37.93 % of workers aged 41 to 50 years experienced an accident. The rates for workers in their 20s and 30s are lower (10.34 % and 6.90 %, respectively). From the graphs, it can be concluded that with an increase in workers' age, the probability of occupational accidents increases. Accidents occur on-site due to hazardous operations during construction. Although older workers have more work experience, they are also more prone to accidents than younger workers. The consequences of accidents are often worse for older workers. In addition, the number of migrant workers at construction sites should be considered, as it may be relatively high. It is common for migrant workers to be older, less educated, and to lack self-protection awareness. Older workers' physical strength and consciousness have declined, and their learning and reaction speeds have decreased [46, 47]. Coupled with poor on-site living conditions and high physical demands, the risk of accidents among older workers surges [48]. Therefore, as a safety measure, the construction unit needs to limit the age of operators for difficult work, such as high-altitude work and heavy manual labour. Construction enterprises should develop strategies to improve the professional quality of workers, enhance their awareness of construction safety, and ensure compliance with operating procedures.

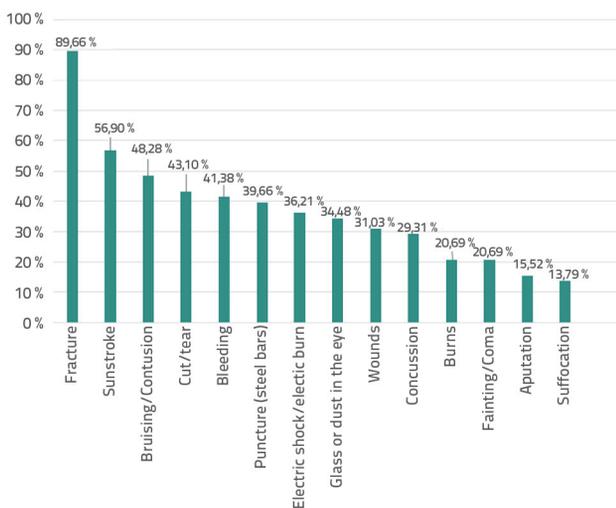


Figure 9. Injuries caused by construction accidents

As shown in Figure 9, fractures are the most common type of injury when occupational accidents occur at construction sites. Subsequently, from the high-rate to low-rate injury types that appear as the consequences of occupational accident occurrence are: sunstroke, bruise/contusion, cut/laceration, bleeding, puncture of steel rebar, and so on. Owing to high-altitude work on site, proper operations or personal protective equipment were not in place, which may have caused the

operator to fall and fracture. Tower cranes at construction sites carry objects to high altitudes, which may fall, resulting in workers being struck and fractures. Operators working on heavy machinery may sustain injuries, including cuts and bleeding. The direct cause of sunstroke is closely related to the temperature at the site. Owing to the large labour intensity of construction and long working hours in open-air places, workers are exposed to the sun and high temperatures, especially during summer. Therefore, some personnel are prone to sunstroke. Owing to the high intensity of operations and high physical requirements, workers need to carry heavy objects; therefore, they are prone to injuries, such as cuts. Steel bar puncture is an injury that occurs in the process of binding steel bars and is caused by mistakes that cause the steel bars to fall from a height.

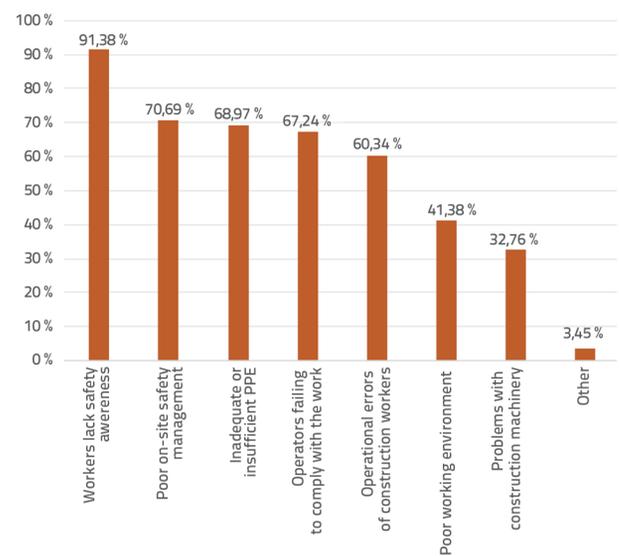


Figure 10. Causes of occupational accidents at construction sites

Approximately 91.38 % of workers agreed that a lack of safety awareness was the main cause of accidents at construction sites, according to the graph in Figure 10. Poor on-site safety management, inadequate or insufficient personal protective equipment (PPE), operators failing to comply with safety procedures, and construction operational errors account for a large proportion of accidents. The lack of safety awareness among construction workers stems from insufficient safety education for employees and a mindset that daily safety knowledge and skills are not important. Some personnel are passive in learning safety measures and fail to guide practice with theory or to consciously regulate behaviour [49]. PPE is an important safety measure to protect construction workers during the construction process and the last line of defence to ensure their safety [50, 51]. Construction enterprises are responsible for providing PPE to construction personnel and for guiding and ensuring that workers use it correctly during

operations [52, 53]. During construction, some employees failed to follow safety procedures for convenience. To complete on time, some construction units urge employees to speed up construction, which may lead operators to fail to comply with operating procedures.

To increase safety on construction sites, a safety management system suitable for enterprises should be designed in line with relevant standards and norms that mandate safety inspections and supervision [54]. The most important aspect for construction operators is safety training, which includes numerous practical exercises. Strategies for strengthening safety training and education include enhancing employees' awareness of safety production, providing targeted training for employees in different positions and work types, and strengthening the promotion of safety knowledge [55]. A safety culture in the construction industry must be considered from multiple perspectives, including corporate, management, technical, and industry cultures, to establish a safety-centred corporate culture and foster a positive safety atmosphere [56]. As the construction market develops, construction enterprises should train construction personnel to develop appropriate safety awareness, behavioural skills, and safety values. This practice showed that enterprises that conducted extensive safety education and improved employees' safety awareness notably reduced accident costs and overall costs [57]. One key to reducing casualties and ensuring safe construction is to strengthen safety education and training for construction personnel [58, 59].

Other important hazards at construction sites are fire and explosions. A fire that occurs during construction can cause casualties and significant economic losses. Therefore, it is necessary to implement fire protection management, which can be carried out in the following steps. First, construction projects can be divided into office, construction, material, and residential areas. To improve safety management in each area, appropriate safety precautions should be adopted based on each area's characteristics. For example, firefighting equipment and fire safety warning signs can be placed in a material area to prevent fire [60]. Second, safety measures are actively implemented at construction site entrances and exits, helping ensure the effectiveness of safety management. A guard could be assigned at the site's entrance and exit for 24 h to check personnel, vehicles, and other items to prevent the entry of any explosive material onto the site [61]. In addition, a patrol team could be on duty during the day and night to facilitate timely investigations and identify risk points.

5. Conclusion

Construction sites are prone to various types of safety accidents, including falling from heights, slipping, tripping, falling at the same level, and being struck by falling objects. This study contributes to the investigation of occupational accidents, safety behaviours, and injury types at construction sites across

three regions of China: Shanghai, Qinghai, and Henan. The collected data revealed the characteristics of safety behaviour and injuries that occurred at construction sites in this particular area. Overall, the investigation on occupational accidents, safety behaviour, and injuries at construction sites in three regions in China shows that the top four main reasons for accident occurrence are workers' lack of safety awareness (more than 90 %), poor site safety management (70 %), insufficient or imperfect PPE (68 %), and operators not following work procedures (67 %). Moreover, this survey provides us with the insight that an efficient measure to reduce occupational accidents is to provide regular safety training with many practical exercises to construction workers, as they expressed in this survey that training is an efficient means to learn and acquire construction safety knowledge. Hence, the recommendation for Chinese contractor companies is to provide regular training and education for construction-site staff. It also contributes to increasing awareness of safety measures and how to implement them in daily work on construction sites.

Second, this study found that the probability of an accident increases with worker age. The most common reasons for unsafe behaviour are fatigue and the older age of the staff. Older workers are more prone to occupational accidents and injuries than their younger counterparts, despite having less work experience. One reason older workers are injured is fatigue and age. The recommendation is that there should be an age limit for construction site staff, especially construction workers. Another recommendation is that older workers should be removed from hazardous locations on-site. In addition, the construction site staff should take regular breaks to reduce physical fatigue.

On the other hand, it is vital that the construction unit effectively manages worker safety at construction sites, assesses potential risks to worker security, and prevents accidents as much as possible. Safety management in building projects is complex and requires significant effort. Establishing a safety management system, strengthening training and education to foster a positive safety culture, and taking more comprehensive, effective measures can ensure the safety of construction operations and prevent or reduce accidents.

The limitations of this study include the limited number of respondents, the focus on three regions, and the inclusion of other construction-site staff in the survey.

The suggestions proposed in this study are only a preliminary discussion that must be further developed and implemented in practice. In the future, relevant studies must be conducted, issues affecting construction safety management in construction engineering must be thoroughly examined, and new problem-solving approaches must be investigated and incorporated into safety practices. Simultaneously, we ought to intensify our communication and collaboration with other sectors and domains, learn from the successful experiences and management modes of other industries, and promote further improvement in the construction safety management of housing construction projects.

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