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Occupational Health and Safety Hazards in Masonry Work in Sharjah City

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Abstract: As the third largest emirate in the UAE, Sharjah is a fast-urbanizing region that has grown into a principal cultural, commercial, and educational center of the country. Among the major economic activities in Sharjah, masonry work provides the necessary economic lifeline for the Emirate. Nonetheless, some workers are often unaware of the detrimental effects of their manual work activities on their health. Accordingly, this research seeks to explore the existence and extent of occupational health hazards among workers in the masonry industry in Sharjah. A cross-sectional research design has been carried out to gather relevant data from occupational safety and health (OSH) experts, contractors, and consultants, using semi-structured interviews and surveys. The result shows that masonry workers in Sharjah face physical and chemical hazards, which are caused by high temperatures, dust, vibrations, repetitive weight lifting, as well as the loading and unloading of materials. The findings from the physical hazard show that low lights and high sounds are the highest in terms of frequency, whereas falls from heights are the highest in terms of severity. Further, the findings show that dust is the major chemical hazard faced by the masonry workers in terms of frequency, whereas asphyxiation is the highest in terms of severity. The survey that was conducted verifies the analytic hierarchy process results. For instance, asphyxiation is the most severe factor, accounting for 69% average weight, while dust account for 6% average weight which makes it the least severe chemical hazard, despite being the most common chemical factor in masonry work across Sharjah. The high rates of chemical and physical hazard exposures demonstrate that the current OSH regulations in Sharjah are insufficient in addressing the most prior masonry works hazards.

Keywords: Occupational safety and health; Workplace hazards; Occupational hazards in masonry work; Workplace hazards

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1. Introduction

Occupational illnesses and workplace facilities are crucial public health concerns. According to the International Labor Organization (ILO), over 2 million deaths occur annually due to work-related illnesses or occupational accidents (Buehler et al., 2017). The occupational safety and health (OSH) situation is particularly worse in informal sectors of the global labor industry. Hence, as one of the informal economic sectors in a developing country, the Sharjah masonry works presents a range of OSH risks, which have detrimental short- and long-term effects on the involved masons.

The workers in Sharjah's construction industry perform a range of tasks, such as demolishing, building brick walls, unloading, loading, shaping, and layering; hence, they suffer from various physical, ergonomic, and chemical hazards. Major causes of ergonomic hazards are improperly designed work tools, which cause discomfort and severe pain in the lower and upper extremities, especially in the neck, wrists, hands, backs, and knees (Arya and Sharma, 2021). The hazards often occur due to the mismatch between an individual's physical capabilities and the demands of the allocated task. When carrying or lifting the heavy stones on the shoulders, head, and hands, manual construction workers are exposed to a high risk of discomfort or pain in their neck and shoulders, as well as to problems in their disks and spine. Conversely, accidental hazards

may include being hit by tools or stones, as well as cuts and damage to the hands, eyes, toes, and fingers, which may be caused by blunt or small penetrative objects at workplaces.

Masonry workers perform a range of tasks, including moving and handling objects, which involves using arms and hands to install, position, hold, move, and manipulate materials and objects. Other activities are inspection of structures, materials, and equipment, information collection, communication, and monitoring processes. The masonry job design exposes workers to various physical hazards. According to Wakhayang (2022), approximately 10%of construction injuries involve lacerations and cuts, while about 30%occur due to their contact with workplace materials and parts. Similarly, 21%of the mason injuries involve the workers' arms and hands.

Asphyxiation is a common health and safety hazard reported in masonry and the overall construction industry. Chmieliauskas et al. (2018) identify asphyxiation as the world's leading cause of death and a top five type of construction site accident. Masonry work exposes people to some hazardous construction materials, such as lead, paint thinners, fluorescents, aerosol cans, and asbestos. In this case, the workers encounter the toxic wastes during construction, repairs, and demolition. For instance, asbestos and insolation are the most common demolition waste. Asbestos produces extremely fine, easily inhaled flakes, which increase the risk of cancer and lung diseases to site workers. Universal waste, including electronic waster, spent fluorescent lamps, and mercury-based waste (e.g., relays, switches, and thermostats) are the other prominent chemical hazards. Masonry workers may also encounter polychlorinated biphenyl (PCB) containing ballasts, latex, oil, and contaminated rags in their workplaces. Hazardous oil materials include hydraulic oil from elevators, engine lubricants, vehicle crankcase oil, and refrigeration oil. Contaminated groundwater and soil, spill cleanup waste, and treated wood also predispose workers to detrimental chemical risks.

Although the masonry work has created substantial economic opportunities for Sharjah by creating jobs and revenue streams and complementing the emirate's established projects and constructions work sectors, the practice poses significant occupational health hazards for the involved workers. A lack of awareness about occupational hazards can contribute to their prevalence by hindering risk recognition, undermining safety training efforts, fostering a poor safety culture, impeding regulatory compliance, and influencing psychological factors related to risk perception. Therefore, promoting awareness and education about workplace safety is crucial for reducing the prevalence of occupational hazards and ensuring the health and well-being of workers. Particularly, the masons face various workplace health hazards, discomfort, and pain due to their active involvement in construction operations. Accordingly, this research seeks to explore the existence and extent of OSH hazards in the construction industry in Sharjah, specifically in the masonry work sector. The primary objective of the proposed study is to investigate and evaluate the common and significant occupational hazards sustained by the workers at Sharjah masonry works.

2. Literature review

2.1. OSH Integration and Occupational Hazards

The masonry and construction industries may exhibit various substandard working conditions that predispose workers to a range of occupational risks. Earlier researchers in the field of workplace health and safety focused on the effective adoption and application of OSH risk mitigation strategies in companies and industries. For instance, Liu et al. (2020) establish that the workplace assessment of occupational risks, especially on major construction sites, should be the first and major step in promoting workplace safety, which includes making competitive decisions in safety programs. Additionally, the research highlighted that the majority of safety efforts in construction are applied informally, based on the assumption that a mere allocation of more resources to safety management initiatives automatically improves site safety. Suárez et al. (2017) emphasizes the need for countermeasures, such as creating risk factor awareness, providing appropriate personal protective devices, offering employee training, and eliminating overtime programs to effectively reduce occupational hazard prevalence. Institution-based cross-sectional research on building and construction workers in Gondar City, Ethiopia, identified the insufficient development or incorporation of OSH risk mitigation protocols in worksites as a leading cause of hazards (Tolera, 2016). According to Mohandes and Zhang (2021), OSH knowledge deficiency is manifested in the safety challenges witnessed in industrial and construction practices. The findings are supported by Liu et al. (2020), who conclude that OHS risk mitigation is not systematic across industrial and construction fields, despite the recent improvements in workplace practice laws and management systems. Generally, researchers attribute the rampant occupational hazards in construction and masonry industries to incompetent OSH risk mitigation efforts at industrial and organizational levels.

2.2. Occupational Safety and Health in the UAE

The rapid industrialization and economic diversification witnessed in the UAE have become a significant threat to people's safety and health due to high risks of exposure to hazardous chemical and physical agents at workplaces. According to Loney et al. (2012), the high risks of OSH hazards are caused by improperly designed working environments, which may lack appropriate safety measures; hence, they pose severe health consequences to the affected workers. The majority of the workers, who are mostly viewed as economic migrants, possess low levels of training and education, which increases their vulnerability to manipulation by non-health-and-safety-compliant companies (Stirzaker, 2017). Ultimately, many workers in the construction and industrial sectors are exposed to substantial occupational health hazards that increase their risk of contracting work-related illnesses, which vary from mild pain and discomfort to cancers.

The World Health Organization (WHO) defines OSH as the health and safety aspects in work environments with the primary objective of averting hazards. Based on the WHO 2019 estimates, between 20% and 50% of workers globally are exposed to different work hazards, with newly industrialized and developing countries reporting higher rates of such risks (Alamneh et al., 2020). Similarly, the ILO reports that the economic costs of work-related hazards are between 1.8% and

6% of gross domestic product. OSH is a particularly complex topic in the UAE due to the unusually mixed population of the country's labor force (Rupakheti et al., 2018). According to the findings by Stirzaker, (2017), the prevalence of socially, academically, religiously, and culturally diverse groups of workers in the UAE creates an exceptional challenge for OSH. Furthermore, the communication difficulties experienced at workplaces may lead to misunderstanding of safety and safety protocols, whereas educational and cultural disharmony may undermine the workers' awareness of safe working practices, which could be compounded by fatalistic religious and cultural attitudes. Generally, OSH is a fundamental topic that has become more prominent in the UAE due to the country's recent developments in the construction and industrial sectors as part of the country's economic diversification agenda.

Despite the growth in the standards of the health and safety sector in the Middle East over the last decade, the region has not yet attained globally accepted standards of safety at workplaces. According to Stirzaker (2017), 19% of Dubai-based construction companies experience severe deficits in health and safety policy knowledge. The construction workers in the Middle East, including the Sharjah masons, encounter a range of potential workplace hazards.

Apart from the physical hazards, construction workers face chemical hazards at their workplaces (Ridley and Channing, 2013). Particularly, the UAE's characteristically high temperatures during the summer expose masonry workers to heat rash, heat stroke, and cramps (Luke et al., 2022). The main issues caused by chemical hazards include headaches, dizziness, and breathing difficulties. Therefore, workers in the construction sector, which includes masonry services, are susceptible to different environmental, chemical risks that cause pain, deaths, and disabilities to the affected individuals (Ridley and Channing, 2013). Table 1 summarizes the types of physical and chemical hazards in masonry work in Sharjah.

Table 1. Types of Physical and Chemical Hazard in the masonry work

Physical Hazard	Chemical Hazard
Low lights and high sounds (L)	Dust (Du)
Discomfort and severe pain in lower and upper extremities (D)	Construction hazardous waste (CH)
Trips and slips (T)	Asphyxiation (A)
Heat stroke (H)	
Struck by moving machinery or piece of moving machinery (S)	
Struck by falling/collapsing objects (SF)	
Falls from heights (F)	
Motor vehicle crashes (M)	
Electrocution (E)	

3. Methodology

3.1. Research Design

A cross-sectional research design is used to gather relevant data from experts, health and safety officers, contractors, consultants, and site supervisors to understand and investigate the significant occupational hazards encountered by the workers. The cross-sectional approach is suitable for the study because it facilitates the simultaneous comparison of multiple variables (Amissah et al., 2019). The study is confined to the masonry workers in the region because of Sharjah's heterogeneous population and its importance to the UAE's economic diversification, particularly for its projects and constructions work sectors. In this research, the opinions of active OSH experts are utilized. The participants are selected randomly from the larger population of construction firms in cities of the Sharjah region.

3.2. Data Analysis

The research data are summarized using qualitative and descriptive statistical techniques. Frequency distribution and analytic hierarchy process (AHP) methods are used to analyze and organize the collected data. AHP is a method for multi-criteria decision making that hierarchically structures complex problems, simplifying the evaluation of relevant criteria. It aids decision makers in assessing the relative importance of attributes in a decision-making scenario. The process begins with pairwise comparisons among the factors, serving as the initial step in AHP. A nine-point scale, known as the Saaty scale (1- Equal Importance, 3- Moderate importance, 5- Strong importance, 7- Very strong importance, 9- Extreme importance, with 2, 4, 6, and 8 values being in between), is commonly used to rank the importance of two attributes,. This scale provides a structured framework for assigning relative values to various factors, facilitating informed decision-making within the AHP framework. To calculate criteria weights, a pairwise comparison matrix [A] is created. This matrix is reciprocal, with $a_{ij\_} = 1/a_{ji}$. The pairwise comparison results are placed in the upper triangle of the matrix, with the main diagonal as 1 and the lower triangle as the reciprocal of the upper. The normalized matrix [A1] is obtained by dividing each element by its column sum and then averaging each row. Eigenvalues and eigenvectors are calculated to determine the maximum eigenvalue and the dominant vector. The consistency ratio (CR) is used to check result reliability, which is the ratio of consistency index (CI) and random index (RI). If CR is less than 10%, the pairwise comparison matrix is acceptable; otherwise, it is suggested to update the matrix to eliminate inconsistency. The two analysis techniques help in validating the hazards priorities, which

are analyzed to assess the OSH regulations that concern the construction activities in the emirates of Sharjah. In this case, the hazards are operationalized as physical damage or chemical harm to a worker's body caused by a workplace object or chemicals/dust.

4. Results and Discussion

For the AHP analysis, the study targeted six experts from the Sharjah Prevention and Safety Authority, who were selected for the Salama Preventive Training and the Sharjah OSHJ system and guidelines for government, semi-government, and private sectors. The results fall within the acceptable ranges of the AHP analysis consistency measures, with weights calculated from the opinions of Sharjah OSH experts. Table 2 shows the pairwise comparison matrix taken from these experts. Table 3 shows the resulting weights obtained by the AHP method and their ranking. The AHP analysis reveals that the most critical safety risks include falls and vehicle-related incidents, with respective weights of 27.0% and 23.0%. Trips follow with a weight of 19.0%, while heat-related risks and musculoskeletal disorders (MSD) are also significant, with weights of 9.8% and 6.5%. Lesser, but still notable, risks include being struck by falling objects (5.7%) and general struck-by incidents (4.4%). Low lights and electrocution are the least significant risks, with weights of 3.1% and 1.5%. The CR of 7.2% indicates reliable and consistent pairwise comparisons. Thus, preventive measures should prioritize falls, vehicle incidents, and trips, while still addressing other risks proportionately.

Table 2. Pairwise comparison of the decision matrix

	L	F	H	T	S	E	D	SF	M
L	1	0.14	0.25	0.17	1	3	0.5	0.5	0.14
F	7	1	4	2	4	9	6	4	2
H	4	0.25	1	0.33	2	7	3	3	0.2
T	6	0.5	3	1	4	7	4	5	1
S	1	0.25	0.5	0.25	1	6	0.25	0.5	0.25
E	0.33	0.11	0.14	0.14	0.17	1	0.12	0.2	0.11
D	2	0.17	0.33	0.25	4	8	1	1	0.12
SF	2	0.25	0.33	0.2	2	5	1	1	0.33
M	7	0.5	5	1	4	9	8	3	1

Table 3. Resulting weights for the criteria based on pairwise comparisons

Cat	Hazard Type	AHP Weight	Rank
1	light	3.10%	8
2	falls	27.00%	1
3	heat	9.80%	4
4	trips	19.00%	3
5	struck	4.40%	7
6	electrocution	1.50%	9
7	MSD	6.50%	5
8	struck by fall	5.70%	6
9	vehicle	23.00%	2

CR = 7.2%

Further, for descriptive statistical analysis the survey targeted 21 participants from different construction companies in Sharjah city. Figure 1 shows that the majority of responses, comprising approximately 61.9% of the total count, were provided by health, safety, and environment (HSE) officers. Following closely behind, approximately 28.6% of responses were contributed by consultants or contractors. The remaining portion of responses, accounting for 9.5%, came from site supervisors.

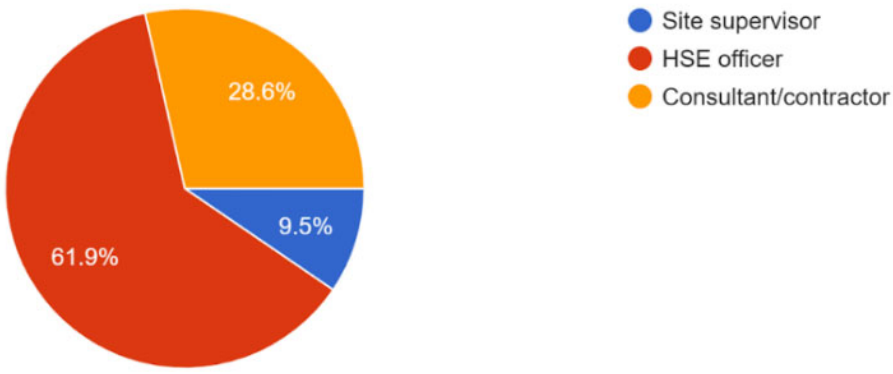

Fig. 1. Count of respondents for the survey

Table 4 provides a breakdown of the frequency and average weight severity for various hazards encountered in masonry workplaces in Sharjah. Low lights and high sounds have the highest frequency, occurring during 30% of working hours, but they have relatively low severity, with an average weight of 2%. While they occur frequently, their low severity suggests that while they may cause discomfort or distraction, they are less likely to result in serious injuries or long-term health effects. However, it is important to address these factors as they can contribute to decreased productivity and potentially increase the risk of other hazards due to impaired visibility or communication.

Falls from heights, despite being less frequent (3%), is identified as the most severe hazard, with a high average weight severity of 29%. This underscores the critical importance of implementing stringent safety measures such as fall protection systems, proper training, and regular inspections to prevent falls and mitigate their severe consequences.

While discomfort and pain in extremities are relatively common (22%), their low severity (2% average weight) suggests that they may not lead to significant long-term health issues if addressed promptly. However, continuous exposure to ergonomic hazards could potentially increase the risk of (MSDs) over time, necessitating ergonomic interventions and regular breaks to reduce strain on workers. With moderate frequency (16%) and severity (4% average weight), trips and slips represent a significant but manageable hazard. Proper housekeeping, footwear, and hazard identification can help reduce the occurrence of trips and slips, minimizing the risk of injuries in the workplace. Heat stroke is relatively infrequent (11%) but carries a severity average weight of 6%. In hot climates like Sharjah, heat stress can be a serious concern, especially for outdoor workers. Adequate hydration, rest breaks, and access to shaded areas are essential to prevent heat-related illnesses.

While less frequent (8%), being struck by moving machinery carries a significant severity risk (12% average weight). Proper training, machine guarding, and adherence to safety protocols are crucial in minimizing the risk of accidents involving moving machinery. With a frequency of 6% and a severity average weight of 9%, being struck by falling objects presents a notable risk in masonry workplaces. Implementing measures such as proper storage, securing materials, and wearing appropriate head protection can help mitigate this hazard. While less frequent (2%), both motor vehicle crashes and electrocution pose high severity risks (14% and 23% average weight respectively). Strict adherence to traffic rules, vehicle maintenance, and electrical safety protocols are essential to prevent these catastrophic incidents.

Low lights and high sounds emerge as the most significant physical hazard in Sharjah masonry work. Compared to other health risks investigated in this study, low lights and high sounds are the most frequent hazard, accounting for 30% of the overall physical health risks at the places of work. With a 67% average weight, dust is the most important chemical hazard due to its higher frequency than construction hazardous waste and asphyxiation. Conversely, electrocution is the least significant physical hazard factor because it occurs less frequently, constituting only 2% of the average frequency weight. The study also identified asphyxiation as the least significant chemical factor at masonry workplaces, based on its low frequency of 6% average weight. Therefore, Sharjah masonry workers are more likely to encounter dust and low lights and high sounds in their workplaces than any other chemical or physical factor examined in this study.

Table 5 presents information on the frequency (Figure 2) and severity of chemical hazard factors (Figure 3) encountered in masonry workplaces in Sharjah. With a high frequency of occurrence (67%), dust is a pervasive hazard in masonry workplaces, likely resulting from activities such as cutting, grinding, and drilling of materials like concrete and stone. Despite its common occurrence, the relatively low average severity weight of 6% suggests that while dust exposure may cause respiratory irritation and other health issues, it may not lead to severe long-term health effects when compared to other chemical hazards. Although it occurs less frequently than dust (27%), construction hazardous waste poses a significant risk due to its higher average severity weight of 25%. This indicates that when workers come into contact with hazardous waste materials such as chemicals, solvents, or toxic substances, the potential for severe health consequences is considerable, emphasizing the need for proper handling and disposal procedures. Despite its low frequency of occurrence (6%), asphyxiation is identified as the most severe chemical hazard factor, with the highest average severity weight of 69%. Asphyxiation primarily arises in confined spaces due to oxygen deficiency or the presence of toxic gases, highlighting the acute danger it poses to workers' lives. The substantial severity weight emphasizes the critical need for stringent safety protocols, including thorough confined space entry procedures and effective ventilation systems, to mitigate the risk of asphyxiation-related incidents and ensure the safety and well-being of workers.

While dust may be the most common chemical hazard, the data suggest that attention should also be given to less frequent but more severe hazards such as construction hazardous waste and asphyxiation. This indicates the importance of prioritizing control measures and allocating resources based on both the frequency and severity of chemical hazards. Moreover, the findings underscore the need for comprehensive risk assessments, regular monitoring, and robust safety training programs to effectively mitigate the diverse range of chemical hazards present in masonry workplaces.

Table 4. Frequency and Severity of physical hazard factors

Frequency		**Severity**	
Hazard Type	Average weight	Hazard Type	Average Weight
Low lights and high sounds	30%	Falls from heights	29%
Discomfort and severe pain in lower and upper extremities	22%	Electrocution	23%
Trips and slips	16%	Motor vehicle crashes	14%
Heat stroke	11%	Struck by moving machinery or piece of moving machinery	12%
Struck by moving machinery or piece of moving machinery	8%	Struck by falling/collapsing objects	9%
Struck by falling/collapsing objects	6%	Heat stroke	6%
Falls from heights	3%	Trips and slips	4%
Motor vehicle crashes	2%	Discomfort and severe pain in lower and upper extremities	2%
Electrocution	2%	Low lights and high sounds	2%
Total	100%	Total	100%

Table 5. Frequency and Severity of chemical hazard factors

Frequency		**Severity**	
Hazard type	Average	Hazard type	Average
Dust	67%	Asphyxiation	69%
Construction hazardous waste	27%	Hazardous waste	25%
Asphyxiation	6%	Dust	6%
Total	100%	Total	100%

5. Conclusion

The masonry workers face various types of hazards with different levels of severity in their work environment. The study results confirm the hypothesis that the masonry workers in the Emirate of Sharjah face physical and chemical hazards, including asphyxiation, dust, falls from heights, low lights and high sounds, discomfort, and severe pain in lower and upper extremities, as well as trips and slips. Other risks are being struck by moving machinery or pieces of moving machinery, being struck by moving or collapsing objects, motor vehicle crashes, and electrocutions. The occupational risks result from high temperatures, dust, stress, vibrations, repetitive weightlifting, as well as the loading and unloading of materials. The frequency and severity of the occupational hazards vary significantly. For instance, asphyxiation is the most severe factor, accounting for 69% average weight, while dust's 6% average weight makes it the least severe chemical hazard, despite being the most common chemical factor in masonry work across Sharjah. The high rates of chemical and physical hazard exposures demonstrate that the current OSH regulations in Sharjah are insufficient in addressing the most prominent hazards in masonry work.

Our research contributes novel insights into the existing body of work on occupational hazards in the construction industry, particularly in the context of masonry work in Sharjah. By investigating the prevalence and severity of occupational hazards among masonry workers in this region, we expand upon current knowledge and fill existing gaps in understanding. Furthermore, our research goes beyond mere identification of hazards by also assessing their frequency and severity. By quantifying the occurrence and impact of these hazards, we provide valuable quantitative data that can inform risk management strategies and prioritize interventions to protect worker health and safety effectively. Moreover, our study

incorporates insights from multiple stakeholders, including OSH experts, contractors, and consultants, through semi-structured interviews and surveys. This interdisciplinary approach enables a nuanced examination of occupational hazards from various perspectives, enriching the depth and breadth of our findings.

The findings present critical hazards in the masonry sector and will help them address the deficiencies of the current OSH practices in Sharjah and in the UAE. Accordingly, government agencies and other industry stakeholders should consider reviewing their current OSH policies to impose more punitive measures for OSH guideline violations to minimize workers' exposures to health hazards. Similarly, the government should restrict the use of construction materials with hazardous compounds, such as asbestos and lead, in the country and help the masonry industry to develop and adopt less toxic construction chemicals and materials. Moreover, construction companies should adopt new and more sophisticated machines and technology to avert ergonometric health risks.

Since the research only sampled a section of Sharjah experts, contractors, consultants, and site supervisors, it may fail to capture industry-wide representative data on the state of occupational hazards in the UAE. Frontline workers are excluded from the survey since they are not well educated in safety measures. Besides, the self-reported results may be susceptible to biases and subjective interpretations. Therefore, future researchers might consider using a larger sample size across different emirates to obtain a wider range of information on health and safety in the masonry sector.

Despite the popularity of AHP, there are shortcomings that cannot be ignored. AHP's applicability may be undermined by rank reversal and number of comparisons. In this case, the ranking of AHP-determined alternatives may change when another alternative is added for consideration. For instance, when decision-makers use AHP for technology selection, they may witness a reversal in the ranking of technologies when a new one is added to the existing list (Khaira and Dwivedi, 2018). Besides, since AHP utilizes redundant judgments to check consistency, it may lead to an exponential rise in the number of judgments elicited from decision-making.

For future research, it is essential to delve into either the economic ramifications of occupational hazards or the efficacy of targeted safety interventions. One avenue of investigation could focus on assessing the economic impact of occupational hazards within the masonry industry in Sharjah. Alternatively, future studies could concentrate on evaluating the effectiveness of specific safety interventions aimed at mitigating occupational hazards among masonry workers in Sharjah.

Author Contributions

Mohammad Khadem contributes to conceptualization, methodology, validation, analysis, investigation, data collection, draft preparation, manuscript editing. Sujan Piya contributes to data collection, analysis, and manuscript editing. Mohammad Shamsuzzaman contributes to visualization, supervision and manuscript editing.

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