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Occupational Accidents, Injuries, and Associated Factors among Migrant and Domestic Construction Workers in Saudi Arabia

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Abstract: The number of migrant workers in Saudi Arabia (SA) has gradually increased, particularly in the construction industry, where migrant workers make up 89% of the workforce. Migrant workers frequently experience exposure to dangerous working conditions and increased risk for occupational injury and hazards due to the work they typically perform. Despite this, there is a lack of comprehensive studies comparing occupational accidents and injuries between migrant and domestic workers. To address this challenge, this study explores the differences between migrant and domestic workers' injuries and occupational accident rates in SA's construction industry. Data were analyzed from reported accidents and injuries obtained from the General Organisation for Social Insurance (GOSI) between 2014 and 2019. Chi-square test was used to examine the associations of occupational accidents and injuries among migrant and domestic workers. Migrant workers experienced higher incidences of falls, strikes, collisions, abrasions (wounds caused by scraping), bodily reactions (e.g., chemical reactions), and car accidents compared to domestic workers. Furthermore, migrant workers aged 30–39 and domestic workers aged 20–29 experienced more severe injuries and higher seasonal mortality rates during the six-year period examined (2014–2019). In addition, domestic workers achieved a higher proportion of full recovery across all types of accidents, except for transport and car accidents related to construction. The findings emphasize the need for ongoing safety education, training, and improved safety measures to protect the health and safety of construction workers, especially migrant workers.

Keywords: construction industry; migrants; occupational accidents; occupational injuries; Saudi Arabia

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Citation: Alruwaili, M.; Carrillo, P.; Soetanto, R.; Munir, F. Occupational Accidents, Injuries, and Associated Factors among Migrant and Domestic Construction Workers in Saudi Arabia. *Buildings* **2024**, *14*, 2714. https://doi.org/10.3390/buildings14092714

Academic Editors: David Arditi, Md Morshed Alam and Paulo Santos

Received: 29 May 2024
Revised: 22 July 2024
Accepted: 27 August 2024
Published: 30 August 2024

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1. Introduction

The International Labour Organization estimates that 63% (164 million) of foreign migrants have jobs, with 58% of them being men [1]. These migrant workers originating from lower-income countries fill critical gaps in higher-income countries, working in the manufacturing, construction, transportation, storage, and agriculture sectors. Notably, substantial global research, including studies by [2,3], underscore the heightened vulnerability of migrant workers to injury, disease, and fatal accidents in comparison to domestic workers, particularly in the construction industry. This risk disparity is evident in 73% of countries, as shown in a recent analysis of ILO data on work-related fatalities, whereby migrant workers in the construction industry had a higher incidence rate of fatal occupational injuries than their domestic counterparts [4–6]. 'Slipping, tripping, or falling on the same level' are reported as the cause of most injuries [7,8], while 'falling from a height', 'hit by an object', 'shocked by the electrical current', or 'run over by moving machinery or cars' are reported as the cause of many more occupational deaths to migrant workers than those of their domestic counterparts [9,10]. Furthermore, a study of migrant workers

in Korea reports 73% of fatal accidents occur among migrant workers compared to the domestic workers [11]. Studies have also shown that migrant workers face higher risk of non-fatal accidents than their domestic counterparts [12]. For example, in Qatar, there were 37.34 non-fatal occupational injuries per 100,000 migrant workers compared to 1.58 for domestic workers [13]. Similarly, a study from the Republic of Korea reported a 1.8-fold higher fatality rate of work-related injuries among Chinese migrant workers compared to Korean-Chinese workers [11]. Research has also shown that more accidents and injuries occur during the summer, especially among migrant workers [14]. This may be due to longer work hours, better weather, and more outdoor time [15].

Saudi Arabia (SA) has recently become a labor-importing country, and the number of migrant workers has gradually increased, particularly in the construction industry; most construction workers are Filipinos, Indians, Pakistanis, and Bangladeshis [16]. In 2021, 6.17 million migrants (76.4% of the workforce) worked in Saudi Arabia's private industry [17], where approximately 51% of the 69,241 occupational injuries in 2014 occurred in the construction industry [18,19]. Abukhashabah et al. [20] noted that the most common injuries and deaths in construction in Jeddah arose from falls from height and electrical shock. However, the demographics, seasons, and details of these kinds of injuries among migrants and domestic workers remain unclear. Despite studies on injuries and occupational accidents in SA's construction industry [20–22], there is limited information on the influence of seasons on such injuries since 2011 [23]. Recognizing the seasonal impact on injuries and related policies is vital for addressing weather-related hazards and workload fluctuations, to enhance worker safety. Furthermore, the types of fatal and non-fatal occupational accidents and injuries between migrant and domestic workers' injuries have not been fully explored using incident data from the General Organisation for Social Insurance (GOSI), a Saudi Government database which contains data on 98.7% migrant and 1.28% domestic workers on reported cases of work-related accidents. This study therefore aims to explore types of occupational accidents and injuries reported by demographic characteristics including by migrant and domestic workers using data from 2014 to 2019 obtained from GOSI. This study aims to analyze the data using descriptive statistics and include analyses by season as well as by types of fatal and non-fatal accidents and injuries among migrant workers and their domestic counterparts.

2. Materials and Methods

2.1. Study Design

This study utilized a retrospective cohort design to examine occupational accidents and injuries among migrant and Saudi (domestic) construction workers in Saudi Arabia. Data used in this study were obtained with permission from GOSI https://www.gosi.gov.sa/en/StatisticsAndData/AnnualReport (accessed on 15 March 2023), which holds extensive records of reported work-related accidents and injuries.

2.2. Data Collection

Data were extracted from the GOSI database (Table 1), focusing specifically on the construction industry. The dataset included details on the frequency of accidents, types of injuries, demographic characteristics (age and nationality), and the consequences on the worker (recovery, under-recovery, disabilities, and fatalities).

Table 1. GOSI occupational accidents and injuries dataset overview.

General Organization for Social Insurance (GOSI)	
Data Categories	**Description**
Workers	Categorization as Saudi (domestic) or non-Saudi (migrant)
Time period provided	2014–2019
Fatal and Non-Fatal Accidents/Injuries	Fatal accidents: Resulting in death Non-fatal accidents: Resulting in >1 day of work absence
Type of Accidents/Injuries (Recorded by GOSI)	Falls Strikes and Collision (struck by objects or materials) Rubbing and Abrasion (injuries from scraping or abrasion) Transport and Vehicle Accidents that related to construction Bodily reactions (reactions to chemicals or materials) Other
Consequences of work-related accidents	Full recovery Under recovery Permanent disability Fatality (death)
Seasons	Spring (March–May) Summer (June–August) Autumn (September–November) Winter (December–February).
Age Groups	<20 years 20–29 years 30–39 years 40–49 years 50–59 years 60+ years
Industry	Construction

2.3. Ethical Considerations

The data obtained from the GOSI were fully anonymized. As this was a secondary data analysis, ethical approval was not required from the University's Human Ethics sub-committee.

2.4. Statistical Analysis

First, GOSI data were used to compare fatal and non-fatal accidents and injuries in Saudi Arabia's construction industry to those in other industries using the following formula:

$$Fatal\ Accident\ Rate = \frac{Number\ of\ Accidents}{Number\ of\ Employees\ (in\ thousands)} \times 100,000$$

$$Non-Fatal\ Accident\ Rate\ = \frac{Number\ of\ Accidents}{Number\ of\ Employees\ (in\ thousands)} \times 1000$$

Employing percentages, the study examined the associations between worker age group, seasonal accident types, and the consequences of these incidents including full, partial, or under recovery, as well as fatality. Chi-square tests were used to evaluate the associations between migrant and domestic worker status by age, and accident consequences (full, recovery, under-recovery, permanent disability, and fatality) for migrant and domestic workers by season. A p-value of 0.05 was used to consider statistical significance in all analyses. Data were analysed using SPSS version 27 for Windows and Microsoft Excel 2021.

3. Results

3.1. Accidents Trends

Table 2 shows the workforce and accident trends in the construction industry and all other industries between 2014 to 2019. On average, 41.4% of all accidents from 2014 to 2019 were reported. The average fatal accident rate (per 100,000) for the same period was 4.2% in the construction industry, while there were 5.4 non-fatal accidents for every 1000 construction workers.

Table 2. Construction accidents overview and accident rates Saudi Arabia (2014–2019).

Variables	2014	2015	2016	2017	2018	2019	Average
Accidents	32,781	31,085	18,681	15,389	13,442	10,621	22,275.6
% Compared to Total Accidents for All Industries	47.3%	46.3%	35.0%	36.3%	36.5%	34.76%	41.4%
Fatality Rate (Per 100,000)	7.9	4.8	4.2	3.3	2.5	2.6	4.2
Non-Fatal Accident Rate (Per 1000)	8.3	7.3	4.3	3.8	4.1	4.6	5.4

Figure 1 shows the number of accidents and injuries affecting construction industry workers throughout the various seasons between 2014 and 2019.

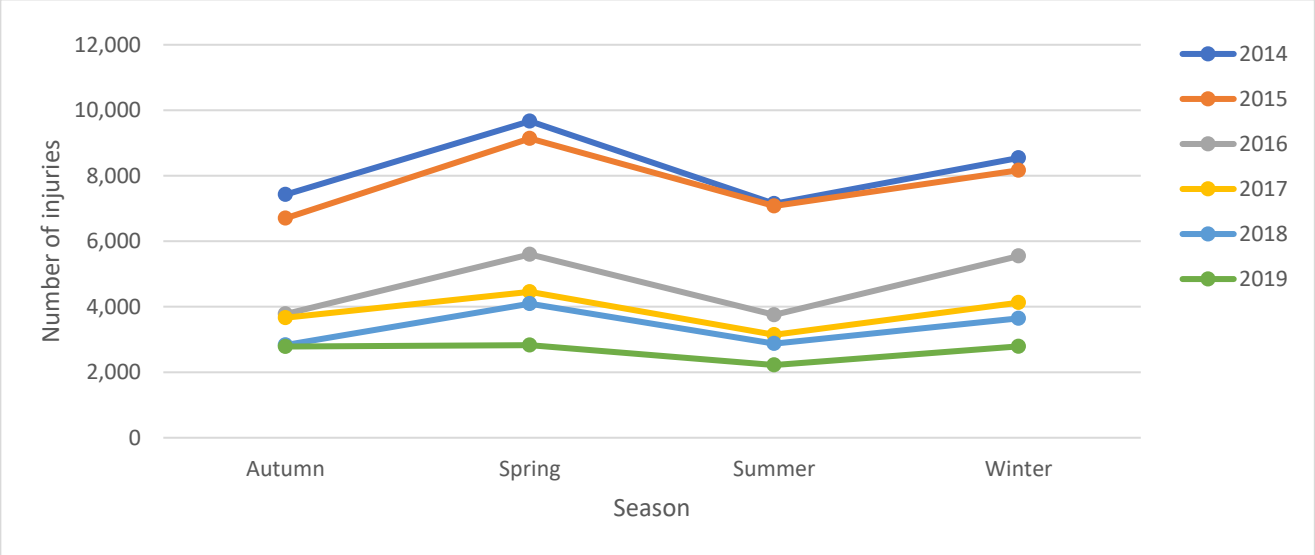

Figure 1. Distribution of accidents (%) by season each year in Saudi Arabia's construction industry.

3.2. Fatal Accidents: Among Migrant and Domestic Workers

Table 3 presents the number and percentage of accident fatalities among domestic and migrant workers in the Saudi construction industry. The overall percentage of fatalities was the same (0.1%) for both migrant and domestic workers, but chi-square analyses showed significant differences in fatality rates between the two groups. It was noted that proportionately more fatal accidents were recorded in the age group 30–39 years for migrant workers and in the 20–29 age group for domestic workers ($p < 0.001$). In terms of accident types, there were proportionately more fatalities from transport and car accidents for both migrant and domestic workers (57.7% and 95.0%, respectively). For migrant workers, the second highest fatalities were from falls (19.3%) and for domestic workers, no other

patterns were observed. No significant difference of fatalities by seasons were found for both migrant and domestic workers ($p = 0.90$).

Table 3. Association between fatal accidents and age group, type of accident, and seasons among migrant workers (n = 2,765,611) and domestic workers (n = 347,044).

Variable	Overall [2]	Migrant N [1] (%)	Domestic N [1] (%)	*p*-Value [2]
Fatal accidents				<0.01
No	311,682 (99.9)	2,764,697 (99.9)	346,985 (99.9)	
Yes	973 (0.1)	914 (0.1)	59 (0.1)	
Fatal accidents by age group				<0.001
<20	3 (0.0)	1 (0.0)	2 (3.4)	
20–29	259 (26.6)	231 (25.3)	28 (47.5)	
30–39	324 (33.3)	306 (33.5)	18 (30.5)	
40–49	260 (26.7)	254 (27.8)	6 (10.1)	
50–59	96 (9.9)	91 (10.0)	5 (8.5)	
>60	31 (3.2)	31 (3.4)	0 (0.0)	
Type of fatal accident				0.02
Fall	176 (18.0)	176 (19.3)	0 (0.0)	
Stuck and Collision	99 (10.2)	97 (10.6)	2 (3.4)	
Rubbed and Abrasion	2 (0.2)	2 (0.2)	0 (0.0)	
Other	37 (3.8)	36 (4)	1 (1.7)	
Bodily Reaction	2 (0.2)	2 (0.2)	0 (0.0)	
Transport and Car Accidents	584 (60.0)	528 (57.7)	56 (95.0)	
Seasons				0.90
Autumn	249 (25.6)	232 (25.4)	17 (28.8)	
Spring	263 (27.0)	248 (27.1)	15 (25.4)	
Summer	209 (21.5)	198 (21.7)	11 (19.3)	
Winter	252 (25.9)	236 (25.8)	16 (27.0)	

[1] n (%) shows percentage of fatal accidents. [2] Pearson's Chi-squared test: other accidents were excluded as the study focused on the five common types.

3.3. Non-Fatal Accidents among Migrant and Domestic Workers

Table 4 shows the number and percentage of non-fatal accidents for migrant and domestic workers. The results show proportionately more migrant workers experience non-fatal accidents (4.5%) than domestic workers (0.4%). When examining non-fatal accidents by age group, a proportionately higher non-fatal accidents was recorded in the age group 30–39 for migrant workers, while among domestic workers the 20–29 age group showed a significantly higher incidence rate ($p < 0.001$).

For types of accident, both migrant and domestic workers experienced slightly higher percentage of 'Fall' accidents (32.8% and 31.5%, respectively) followed by "Struck and Collision accidents" (26.9% and 20.7%, respectively), ($p < 0.01$). Again, no significant difference in fatalities by season were found for both migrant and domestic workers ($p = 0.378$).

Table 4. Association between non-fatal accidents and age group, type of accident, and seasons within migrant workers (n = 2,765,611) and domestic workers (n = 347,044).

Variable	Overall n (%)	Migrant N [1] (%)	Domestic N [1] (%)	*p*-Value [2]
Non-fatal accidents				<0.01
No	2,991,629 (96.1)	2,646,095 (95.7)	345,534 (99.6)	
Yes	121026 (4.0)	119516 (4.5)	1510 (0.4)	
Non-fatal accidents by age group				<0.001
<20	45 (0.0)	15 (0.0)	30 (2.0)	
20–29	36,610 (30.2)	35,857 (30.0)	753 (49.9)	
30–39	47,237 (39.0)	46,749 (39.0)	488 (32.3)	
40–49	25,018 (20.7)	24,847 (20.8)	171 (11.3)	
50–59	9843 (8.1)	9790 (8.2)	53 (3.5)	
>60	2273 (1.9)	2258 (1.9)	15 (1.0)	
Type of non-fatal accident				<0.01
Fall	39,626 (32.7)	39,150 (32.8)	476 (31.5)	
Stuck and Collision	32,483 (26.8)	32,170 (26.9)	313 (20.7)	
Rubbed and Abrasion	15,398 (12.7)	15,298 (12.8)	100 (6.6)	
Other	9324 (7.7)	9243 (7.7)	81 (5.4)	
Bodily Reaction	7186 (5.9)	7098 (5.9)	88 (5.8)	
Transport and Car Accidents	5974 (4.9)	5717 (4.8)	257 (17.0)	
Non-fatal accidents by seasons				0.378
Autumn	26,940 (22.3)	26,584 (22.2)	356 (23.6)	
Spring	35,502 (29.3)	35,046 (29.3)	456 (30.2)	
Summer	26,023 (21.5)	25,712 (21.5)	311 (20.6)	
Winter	32,561 (26.9)	32,174 (26.9)	387 (25.6)	

[1] n (%) shows percentage of non-fatal accidents. [2] Pearson's Chi-squared test: other accidents were excluded as the study focused on the five common types.

3.4. Association between Type of Accident and Its Consequences across Domestic and Migrant Workers

Table 5 presents four categories of accident consequences: full recovery, under-recovery, permanent disability, and fatality. The analysis shows a significant difference in accident consequences for migrant and domestic workers ($p = 0.02$). Whilst most migrant and domestic workers made a full recovery from a fall, significantly more domestic workers made a full recovery than migrant workers (66.8% and 60.3%, respectively). Furthermore, whilst no fatalities from a fall were reported for domestic workers, fatalities from a fall were reported for a small proportion of migrant workers (0.4%). In terms of Strike and Collision, Rubbing and Abrasion, and Bodily Reaction, the analysis shows no significant difference in accident consequences for migrant and domestic workers ($p = 0.68$, 0.99, and 0.44, respectively). However, domestic workers recorded significantly more full recovery than migrant workers for all three types of accidents. Both migrant and domestic workers recorded almost no fatalities from Rubbing and Abrasion and Bodily Reaction, while migrant workers reported a small proportion from Strike and Collision (0.3%), while there were no fatalities among domestic workers from this type of accident (0%).

Table 5. Association between type of accident (fatal and non-fatal) and its consequences across migrant workers (n = 2,765,611) domestic and migrant workers (n = 347,044).

	Consequences					
Type of Accident	**Full Recovery n [1] (%)**	**Under Recovery n [1] (%)**	**Permanent Disability n [1] (%)**	**Fatality n [1] (%)**	**Total n [1] (%)**	***p*-Value [2]**
Fall	24,048 (60.4)	12,906 (32.4)	2672 (6.7)	176 (0.4)	39,802 (100.0)	
Migrant	23,730 (60.3)	12,774 (32.5)	2646 (6.7)	176 (0.4)	39,326 (100.0)	0.021
Domestic	318 (66.8)	132 (27.7)	26 (5.5)	0 (0)	476 (100.0)	
Strike and Collision	23,411 (71.8)	7211 (22.1)	1861 (5.7)	99 (0.3)	32,582 (100.0)	
Migrant	23,181 (71.8)	7146 (22.1)	1843 (5.7)	97 (0.3)	32,267 (100.0)	0.676
Domestic	230 (73)	65 (20.6)	18 (5.7)	2 (0.0)	315 (100.0)	
Rubbing and Abrasion	11,218 (72.8)	3145 (20.4)	1035 (6.7)	2 (0.0)	15,400 (100.0)	
Migrant	11,144 (72.8)	3125 (20.4)	1029 (6.7)	2 (0.0)	15,300 (100.0)	0.990
Domestic	74 (74.0)	20 (20.0)	6 (6.0)	0 (0.0)	100 (0.6)	
Other	6345 (67.8)	2345 (25.1)	634 (6.8)	37 (0.4)	9361 (100.0)	
Migrant	6300 (67.9)	2318 (24.9)	625 (6.7)	36 (0.4)	9279 (100.0)	0.054
Domestic	45 (54.9)	27 (32.9)	9 (10.9)	1 (1.2)	82 (100.0)	
Bodily Reaction	5524 (76.8)	1388 (19.3)	274 (3.8)	2 (0.0)	7188 (100)	
Migrant	5456 (76.8)	1374 (19.3)	268 (3.8)	2 (0.0)	7100 (100)	0.445
Domestic	68 (77.2)	14 (15.9)	6 (6.8)	0 (0.0)	88 (100)	
Transport and Car Accidents	2045 (31.2)	3397 (51.8)	532 (8.1)	584 (8.9)	6558 (100)	
Migrant	1973 (31.6)	3235 (51.8)	509 (8.2)	528 (8.5)	6245 (100)	0.001
Domestic	72 (23.0)	162 (51.7)	23 (7.3)	56 (17.9)	313 (100.0)	

[1] n (%), [2] Pearson's Chi-squared test: other accidents were excluded as the study focused on the five common types.

There is a significant difference between the consequences of other types of accidents and transport and car accidents among migrant and domestic workers ($p = 0.05$, and <0.005 respectively). However, in this case, the results show that migrant workers had a higher proportion of full recovery than domestic workers in other types of accidents (67.9% and 54.9%, respectively), while both made the same proportion of under-recovery in transport and car accidents (51.8%). The comparison of interest is other types of accidents among migrant workers versus domestic workers (1.2%, 0.4%), then transport and car accidents among migrant versus domestic (17.9%, 8.8%).

4. Discussion

Using government data, this study examined the prominent types of accidents, their relationships with demographics, seasonality of the events, and the consequences of occupational accidents and injuries among migrant and domestic construction workers in Saudi Arabia from 2014 to 2019. During this period, the construction industry exhibited the highest occupational accident and injury rate, accounting for 41.4% of all industrial incidents. Migrant workers, constituting 89% of the workforce (n = 2,765,611), experienced a disproportionately higher share of both fatal and non-fatal accidents compared to their domestic counterparts, who accounted for only 11% (n = 347,044) of the total cases. Furthermore, these incidents demonstrated seasonal variation, with a higher prevalence during spring and a lower incidence during summer; however, there was no significant difference recorded across seasons. The annual distribution revealed the highest accident counts in 2014 and 2015, whereas 2019 recorded the lowest accident count, a trend that could be potentially attributed to stricter regulations and improved reporting systems.

Significantly more migrant workers experienced non-fatal accidents when compared to domestic workers. This study highlighted the increased susceptibility of migrant workers to severe injuries and permanent impairments in comparison to their domestic counterparts.

Several factors including language barrier, cultural differences, lack of training, extreme working conditions, and housing and living conditions may be attributed to these findings. However, there is a need to be cautious when interpreting these results. The higher vulnerability of migrant workers to accidents in the construction industry could be due to the relatively higher number of migrant workers than domestic workers in the industry. Nonetheless, recent meta-analysis studies across various countries consistently showed higher risks for work-related injuries and fatalities among migrant construction workers compared to domestic workers [23,24]. For example, a study in Spain found that migrant workers had a higher risk of fatal accidents than domestic workers [25], and studies from Denmark and South Korea found higher risks of non-fatal accidents among migrant workers [26,27]. Factors like cultural and language differences increase the susceptibility of migrant workers to accidents and injuries and can hinder effective communication resulting in an increased risk of accidents [28,29]. Insufficient safety education increases the risk, as migrants often do not have access to adequate training and protective equipment [30]. Additionally, migrant workers frequently engage in physically strenuous and perilous labor, enduring extended work hours in the construction industry [31]. Son et al. [26] suggested that vulnerability among migrant workers can be reduced by implementing various measures, such as providing safety training in multiple languages, offering cultural sensitivity programs, and enforcing safety regulations more strictly.

Age played a discernible role in accident occurrence, with migrants aged 30–39 and domestic workers aged 20–29 facing a higher risk of both fatal and non-fatal accidents. A Qatari-based study reported that migrant workers aged between 25–34 and 35–44 faced the highest risk of occupational injuries compared to younger and older workers [13]. Similarly, in United Arab Emirates, workers aged 25–44 were found to have a higher rate of occupational injuries than those in other age groups [32]. This propensity may stem from the physically demanding nature of the work, coupled with over-confidence due to significant work experience, thereby increasing exposure to workplace hazards. Additionally, family responsibilities among workers in this age group may contribute to their pursuit of more demanding jobs, such as those within the construction industry, to provide for their families; future studies may investigate such an association.

Among migrant construction workers, falls and struck-by, collision, were the most prevalent types of non-fatal accidents. Literature has consistently identified falls as a major hazard within the construction industry, particularly for workers operating at heights or on unstable surfaces. In a study from Ethiopia, 16.1% of construction site workers fell from height and most of these workers were plasterers [33]. Similarly, Tuma et al. [34] reported that most fall victims in construction workplace were migrant workers. Likewise, struck-by incidents involving contact with objects or equipment are frequently cited as leading causes of injuries and fatalities during construction activities [20]. The prominence of these accident types among migrant workers suggests that they may face additional risks owing to language and cultural barriers, inadequate safety training, and suboptimal safety equipment. Several studies from different regions have also reported similar trends; studies from Italy and Malaysia demonstrated that migrants are more frequently implicated in workplace injuries than domestic workers [9,35].

This study showed that occupational accidents and injuries are more frequent among migrant workers during the spring season and declining throughout the summer, though the difference was not statistically significant. This contrasts with prior research by Ammar (2019), who reported the highest number of occupational accidents and injuries during the spring, followed by the summer season [22]. This could be attributed to variations in datasets and legislative changes aimed at restricting outdoor work during specific hours. The dynamic nature of seasonal patterns in workplace accidents suggest that these patterns can evolve over time. Another reason for this change might be because of Legislative Decree No. 3337 of 14/05/2014, which stated that 'No worker shall labour in the outdoors from 12:00 p.m. to 3:00 p.m. throughout the summer season (15 June–15 September)' [19]. Consequently, the number of summer injuries and accidents could be lower because of

less and/or shorter duration of activity. This could also explain why there seemed to be more injuries during the spring. The construction industry may increase its work-related activities during spring, to achieve summer deadlines which may increase stress, thereby leading to accidents, and injuries.

Regarding consequences of accident, domestic workers in the Saudi construction industry exhibited a higher proportion of full recovery than migrant workers from all accidents except the Transport and Car Accidents. Migrant workers have more full recovery and a lower proportion of fatalities from Transport and Car Accidents than domestic workers. Our findings are also in line with the findings of Arndt [36] that non-German workers face a higher risk of fatal and non-fatal injuries from falls and from falling objects. However, non-Germans recorded fewer injuries from transport and car accidents compared to German workers [36]. This is because domestic workers often use their personal vehicles for commuting, while migrant workers rely on public transport, which may be safer and less prone to accident.

4.1. Research Limitations

This is a retrospective study based on secondary data; future studies addressing occupational accidents and injuries should consider the reasons of higher injury rates among the 20–49 age group of migrant workers. Therefore, additional observational studies based on primary data are required. There were certain limitations in data collection, as follows.

- The research depends on the GOSI database, which may not record every single incident and could fail to obtain comprehensive knowledge on the particular causes and settings of accidents and injuries. This shortcoming causes possible underreporting or misclassification.
- Using a retrospective cohort design reduces the capacity for determining causation. Potential confounding variables that could affect the observed associations include variations in experience levels, safety training, and the enforcement of safety laws. These variables were not controlled for.
- The findings may not be applicable to industries beyond Saudi Arabia's building industry due to its distinctive socio-economic and regulatory environment.
- The reliability of the data could also be influenced by selection bias and self-reporting inaccuracies, which could potentially distort the results.

4.2. Recommendations and Future Works

Based on the findings, it is recommended that safety measures in the construction industry be drastically improved, particularly among migrant workers. These include:

- Developing more effective and structured safety training programs using advanced technology such as wearable sensors and implementing safety audits and inspections.
- Employers and construction site managers should ensure that migrant workers use personal protective equipment appropriately at all times.
- More attention should be paid to migrant workers with less experience and knowledge of safety measures. This can include providing safety training in their native languages.
- Given the prevalence of psychosocial factors and musculoskeletal injuries in the construction industry, a comprehensive risk management technique must be implemented in order to effectively reduce these risks [37,38]. Further studies should be conducted to examine the causation of work-related accidents among migrant construction workers in SA and its potential impact on occupational health and safety is imperative.

5. Conclusions

This study showed that migrant workers in SA's construction workers faced higher fatal and non-fatal accidents and injuries compared to their domestic counterparts. It emphasizes the vital requirement of focused safety measures in the construction sector, especially for migrant workers. The results highlight the need of continuous safety educa-

tion and training initiatives catered to handle the particular threats experienced by various worker groups. We propose a decision support framework with the following elements to transform these results into useful applications:

1. Routine risk assessments should be implemented to identify high-risk activities and environments that are unique to migrant workers. Development of management plans involving improved safety measures and the supply of personal protective equipment (PPE) to help to reduce identified risks.
2. Develop and implement training programs that are specifically designed to address the distinct safety challenges encountered by migrant workers, with an emphasis on the prevention of falls, strikes, and collisions. Enhance the comprehension and efficacy of migrant workers by providing training that is conveniently accessible in their native languages.
3. Adjust work schedules and safety measures to account for seasonal variations in accident rates, particularly during the spring when accidents are more frequent.
4. Establish a robust monitoring system to track the effectiveness of implemented safety measures and make data-driven adjustments as needed. Regularly review accident and injury data to identify emerging trends and areas for improvement.

By integrating these components into a decision-support framework, construction companies and policymakers can enhance the safety and well-being of all workers, with particular attention to the vulnerabilities of migrant workers. This approach not only addresses the immediate safety concerns but also contributes to a culture of continuous improvement in occupational health and safety practices.

Author Contributions: The study was designed and prepared by M.A., F.M., P.C. and R.S.; M.A. and F.M. designed the study. M.A. conducted an analysis of the data. All authors have read and agreed to the published version of the manuscript.

Funding: Financial support was received for the research, authorship, and publication of this article. This work was funded by Saudi Electronic University as part of a PhD program for the first author.

Data Availability Statement: Some or all data, models, or code used during the study were provided by a third party. Direct request for these materials may be made to the provider as indicated in the Acknowledgments.

Acknowledgments: The authors are grateful to Abdullah Alharbi, Eng. Muataz Al-Khalifah, and Afnan Alsheikh from General Organization for Social Insurance (GOSI) for providing anonymous data on occupational accidents and injuries.

Conflicts of Interest: The authors declare no conflicts of interest.

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