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ORIGINAL RESEARCH

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Occupational injuries among male construction workers in Spain

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Abstract

Occupational injuries are a cause of concern in our society. They are associated with absence at work and early retirement, especially among male workers employed in dangerous sectors such as construction and mining. The aim of the current study is to analyse factors of usual consideration in the sector and assess its influence on accidents from a statistical study. A logistic regression model was used in a sample of 814,775 occupational accidents suffered by male construction workers between 2009 and 2019. This model was based on the calculation of the odds ratio (OR). Results show that among these construction workers, those who were Spanish, under 45 years old, and with more than one year of service were more likely to suffer a neck injury in a light traffic accident. In contrast, workers older than 45 years old and with more than one year of experience were less likely to suffer a head injury. No variable was detected that offered the same protective or risk effect through the different parts of the injured body. For workers in this sector, safety training, and the adaptation of this training to risky profiles and injuries should improve working conditions and injury rates.

Keywords

Injury; Occupational; Construction; Accident; Safety

1. Introduction

Occupational accidents are related with negative consequences for male workers, business, families and society [1]. Occupational injuries are a common cause of absence at work and early retirement, especially among male workers from dangerous sectors such as construction and mining [2]. Labourers involved in construction activity, due to its special characteristics, show the highest rates of accidents among all labourers, a cause for concern throughout the world. In the specific case of Spain, and for the year 2021, a total of 125 fatal accidents were recorded [3], the second highest value if we group the fatal accidents among all areas of the service sector of the economy. Globally, estimates from 2013 show that 60,000 fatal accidents in the construction sector occur each year, or one every 10 minutes. Additionally, of every six fatal accidents, the construction sector is responsible for one of them, and in industrialized countries, the construction sector represents between 6% and 10% of total employment but is responsible for between 25% and 40% of deaths [4].

The special characteristics of the construction industry, its wide casuistry, mean that in addition to detailed considerations of each project, studies must consider conditions related to terrain, place of work, density and type of machinery used, weather conditions, and other factors. For many years such research has been undertaken by industry groups, social organizations, and specialists in the world of prevention of occupational hazards. This attention has originated from studies with different objectives but with the common goal of improving the health of workers of this sector, who are fundamentally men.

Some studies have been concerned with publicizing dangerous working conditions, causes, and possible solutions [5–7]. For instance, those who work at height are especially exposed to accidents with fatal consequences. The use of some specific equipment, such as formworks [5] or ladders [7], is commonly linked to falls from heights, and for this reason previous authors have studied the risks associated with these activities. Another relevant risk factor is the use of automotive heavy equipment at construction sites. In this sense, it has been detected that obstructions, blind spots and lighting conditions are the most common causes in accidents with heavy equipment involved [8]. Similarly, other authors have focused their research on how to analyse the type of accidents and their severity. An example of this can be found in a study about the influence of the hour of the day and alcohol consumption on construction accidents [9].

Other authors have analysed the development and integration of health and safety management systems in the construction sector, and they have detected that some construction firms are integrating effective Occupational Health and Safety (OHS) management systems to improve construction safety [10].

More recently, the integration of new technologies in construction safety has been addressed by different authors [11].

TABLE 1. Definition of the variables analysed.

Variable	Definition	Dichotomized values	
Age	Age of the worker injured	<45 years	>45 years
Nationality	Country of worker injured	National	Foreign
Length of service	Worker's experience in the company	<1 year	>1 year
Staff	Size of the company	Small (<10 workers)	More
Multiple	More than a worker injured in the accident	Yes	No
Traffic	Injuries associated with a traffic accident	Yes	No
Monday	Monday is the day of the accident	Yes	No
Severity	Consequences of the injury	Light	Rest of values (Serious, very serious and fatal)

Some innovative solutions such as the use of exoskeletons to reduce physical requirements [12], or the use of virtual environments as a support tool for health and safety training [13], are being developed in the sector.

As a result of accidents, construction workers suffer injuries in different parts of anatomy of the worker. Depending on the source and the part of the body injured, the severity can be very different [14]. The main injuries found in the construction sector are usually of a mechanical type caused by overexertion, blows or cuts with objects, and falls, most resulting in fractures in the hands and legs [15, 16]. However, fatal accidents used to be associated with head injuries after a fall from height [17]. Based on previous research, it is important to study the influence of variables associated with the part of the body injured, such as the head, neck, back, and extremities [18–21].

Although these types of accidents can be framed within the area of safety, experience suggests that the effectiveness of a prevention programme improves by integrating the four specialties into it that make up the discipline—safety, hygiene, ergonomics-psycho-sociology, and occupational medicine—because the lack of attention to any of them will imply potential damage to the health of the neglected specialty. In this line, it should be noted that recent research shows an increase in poor mental health among construction workers, which mostly materializes in the form of anxiety, affective disorders, and substance use [22, 23].

The numerous contributions and the proposed parameters make clear, on the one hand, the existence of a margin for improvement in safety and health among construction workers and an interest generalized by all the participating actors, and on the other hand a concern to reduce the problems of health derived from this activity. In this sense, our objective is to analyse factors of usual consideration in the sector (age, nationality, experience) and assess their influence on accidents from a statistical study, with the idea that the results will detect the main causes of accidents and improve the protocols of existing safety measures, thus helping to reduce the rate of accidents and improving the health of workers in this industry.

2. Materials and methods

In Spain, all occupational accidents resulting in one absence day or more are required to be notified electronically to the Labor Authority, through the Delt@ platform [24]. Each day the platform receives the reports of all occupational accident communicated by the employers of the injured worker. In our research, the Spanish government provided us with information on 814,775 occupational accidents, corresponding to all occupational accidents reported by male construction workers in Spain from 2009 until 2019. Official data was completely anonymized before it was provided, which removed personal information about workers and companies affected. The data only provided general variables such as age, length of service, or occupation.

Reports provided included 58 variables associated with the occupational accident. Some of them described personal characteristics based on the injured worker (Nationality, gender, age, and experience). Other variables explained characteristics of the organization or company where the accident happened (sector, OHS organization, company size), and others informed about the circumstances of the accident (hour of the accident, deviation, and part of the body injured).

The injured body part was selected as the main variable of the analysis, to measure the influence of injuries on the anatomy of the worker, and accidents were grouped based on the part of the anatomy affected. Following this, other variables were analysed (Table 1).

In the statistical analysis, odds ratio (OR) values were obtained following a logistic regression model [25]. An OR is a measure of the association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure [26]. The relation between the part of the body injured and the rest of the variables studied was analysed using an adjusted OR with a confidence interval (CI) of 95%. The results were calculated using the Statistical Package for the Social Sciences (SPSS), (version 23, IBM, New York, NYS, USA).

3. Results

In the following section, results obtained are described according to the existing literature. The ORs obtained for the main variables studied are shown in Table 2.

TABLE 2. Odds ratios based on occupational accident variables.

Variable	Values	Head		Neck		Back		Upper ex		Lower ex		Multiple	
		OR	CI	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI
Age													
	<45	1.080	1.06–1.09	2.003	1.94–2.06	1.050	1.04–1.07	0.990	0.98–1.00	0.959	0.94–0.96	0.852	0.83–0.87
	>45	1		1		1		1		1		1	
Nationality													
	National	0.791	0.70–0.80	1.536	1.40–1.50	0.856	0.80–0.90	0.939	0.92–0.95	1.217	1.20–1.23	0.950	0.91–0.98
	Foreign	1		1		1		1		1		1	
Length of service													
	<1 year	1.120	1.11–1.14	0.890	0.87–0.91	0.902	0.89–0.91	1.025	1.01–1.03	1.005	0.99–1.01	1.085	1.05–1.11
	>1 year	1		1		1		1		1		1	
Staff													
	Small	1.000	0.98–1.02	0.809	0.79–0.82	0.925	0.91–0.93	1.093	1.08–1.10	0.999	0.98–0.99	1.020	1.00–1.05
	>10	1		1		1		1		1		1	
Multiple													
	Yes	0.791	0.73–0.85	11.560	11.00–12.00	0.707	0.66–0.74	0.311	0.29–0.32	0.338	0.31–0.35	7.810	7.43–8.21
	No	1		1		1		1		1		1	
Traffic													
	Yes	0.236	0.22–0.25	38.800	37.80–39.90	0.624	0.60–0.64	0.220	0.21–0.22	0.295	0.28–0.30	9.654	9.38–9.93
	No	1		1		1		1		1		1	
Monday													
	Yes	0.790	0.78–0.81	0.973	0.94–0.99	1.358	1.34–1.37	0.914	0.90–0.92	0.972	0.96–0.98	0.871	0.84–0.89
	No	1		1		1		1		1		1	
Severity													
	Light	0.558	0.52–0.58	4.449	3.64–5.43	3.143	2.92–3.38	2.311	2.20–2.42	1.214	1.16–1.26	0.100	0.90–0.10
	Serious	1		1		1		1		1		1	

OR, Odds Ratio; CI, Confidence Interval with p-values.

3.1 Head

Head injuries produced significant results for some variables. Male workers younger than 45 years of age (OR = 1.08; CI = 1.06–1.09), with less than one year of experience (OR = 1.12; CI = 1.11–1.14), were significantly and independently associated with head injuries. On the other hand, Spanish nationality (OR = 0.791; CI = 0.7–0.8), traffic accidents (OR = 0.236; CI = 0.22–0.25), and light accidents were linked with a lower probability of head injuries.

3.2 Neck

Concerning neck injuries, statistically significant and independent associations were found among younger workers (OR = 2.00; CI = 1.9–2.1), foreign workers (OR = 1.53; CI = 1.4–1.5), multiple injuries (OR = 11.56; CI = 11.0–12.0), and traffic accidents (OR = 38.8; CI = 37.8–38.9). These results might be associated with some ergonomic issues [27–29]. An example of this can be found in the accidental compression of the neck by a safety harness [20].

3.3 Back

With regard to back injuries, statistically significant and independent associations were found among light accidents (OR = 3.14; CI = 2.9–3.3) and accidents reported on Mondays (OR = 1.35; CI = 1.3–1.4).

3.4 Upper and lower extremities

Regarding upper and lower extremities, statistically significant and independent associations were not found among the majority of the variables studied, such as age, nationality, length of service, and staff. In contrast, they were related with light accidents, especially involving the upper extremities (OR = 2.3; CI = 2.2–2.4).

3.5 Multiple injuries

Concerning multiple injuries, they are typically associated with traffic accidents [30], and as a consequence variable traffic accidents obtained negative values (OR = 9.65; CI = 9.3–9.9). On the other hand, light severity obtained the lowest odds ratio values (OR = 0.1; CI = 0.09–0.1).

4. Discussion

Head results are related with some similar previous results, which suggest that younger construction workers are more likely to suffer a head injury [18]. These results may be due to lower occupational safety training in this group [19]. In this sense, an inadequate use of safety helmets among younger and foreign workers could be responsible for these results [27]. Regard to back results point to the possible existence of a "Monday Effect". This effect has been studied by previous authors [31] as the notification of a light non-occupational accident that occurred on the weekend as an occupational accident that occurred on a Monday. In construction sites, this effect has been detected in similar research [32]. Our results showed the possibility of this effect in the notification of back injuries. The rest of variables studied did not show especially significant results. In the case of lower extremities, some additional preventive measures could mitigate some specific injuries [29]. Finally, results from multiple injuries are aligned with previous studies [33].

5. Conclusions

According to the results, different factors studied were significantly and independently associated with the part of the body injured and factors such as severity, experience, age, and nationality. Among male construction workers, those who were Spanish, under 45 years of age, and with more than one year of service were more probably to suffer a neck injury in a light traffic accident. In contrast, workers over 45 years old and with more than one year of experience were less likely to suffer a head injury. The temporality of the workplace in construction occupations and the mobility of workers may be associated with the relevance of traffic accidents. It would be interesting to carry out more research focused on the traffic patterns of these workers for a better understanding of the problems. In addition, the high OR obtained for back injuries on Monday is a remarkable finding. These results could be associated with hidden injuries suffered on the weekend and reported as an occupational accident. In contrast, multiple injuries typically associated with traffic accidents showed lower ORs on Mondays.

No variable was found that offered the same risk or protective effect through the different parts of the injured body. For example, young age is a protective factor in extremities but a risk factor in head injuries.

The findings from this research could improve the specific design of occupational safety training programmes focused on male workers at construction sites. Workers' OHS training adapted to their occupational risk profile and habitual accidents should improve injury rates among male construction workers.

Regarding the limitations of the study, it should be pointed out that although the present study is based on official data of all accidents recorded by male construction workers in Spain over a period of 11 years, it was not possible to study some influential variables. Only the variables and factors considered in the official form were analysed. The circumstances of the accident could be affected by some additional factors, but if they were not considered as a variable in the official form, then they were not evaluated. In addition, accidents or incidents not notified by the organizations or companies of the injured worker were not analysed because there were no records of them.

ABBREVIATIONS

OR, Odds Ratio; CI, Confidence Interval; MSDs, musculoskeletal disorders.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

AUTHOR CONTRIBUTIONS

MCR—designed the research study. MCR and ENG—performed the research. ENG and ALA—provided help and advice on analyzed the data. ALA—wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. Antonio López Arquillos and María del Carmen Rey Merchán are serving as the Guest Editors of this journal. We declare that Antonio López Arquillos and María del Carmen Rey Merchán had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to EG.

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