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Original Article

Analysis of Workplace Accidents in Automotive Repair Workshops in Spain

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ABSTRACT

Background: To analyze the effects of the factors associated with different types of injury (superficial wounds, dislocations and sprains, bone fractures, concussion and internal injuries, burns scalding and freezing) caused by occupational accidents in automotive repair workshops.
Methods: Study of a sample consisting of 89,954 industry accidents reported from 2003 to 2008. Odds ratios were calculated with a 95% confidence interval.
Results: Belonging to a small company is a risk factor for suffering three of the five types of injury studied. Women are less likely to suffer burns and superficial wounds, and more likely to suffer dislocations or sprains. Foreign workers are more likely to suffer concussion and internal injuries.
Conclusion: Health and safety strategies and accident prevention measures should be individualized and adapted to the type of worker most likely to be injured in each type of accident. Occupational health and safety training courses designed according to worker profile, and improving the participation of the workers in small firms creating regional or roving safety representatives would improve working conditions.

1. Introduction

Prevention of injuries from occupational accidents is a public priority [1], and accordingly several studies on this issue have been conducted in Spain. These studies have focused on different aspects, such as trends over time for fatal injuries caused by occupational accidents across all sectors [2], or the risk of foreign workers suffering occupational accidents [3].

Much research has been done into occupational accidents in hazardous and economically important sectors such as the construction industry [4–6], but, although vehicle repair is an important global economic activity, this sector has been the target of far fewer studies on workplace health and safety than the aforementioned construction industry.

In the United States, 3.9 out of every 100 full-time workers employed in the automotive repair and maintenance sector in 2011 suffered some kind of nonfatal occupational accident or illness, according to data from the Bureau of Labor and Statistics [7]. The accident rate for this industry was higher than that reported by other, apparently more hazardous, sectors such as support activities for mining or the chemical industry, which had rates of 2.3 and 2.4 per 100 workers, respectively [7].

The sector's high accident rate is associated with several different variables, and in their day-to-day activity workers from the sector are exposed to many different risk factors such as high noise levels [8–10], asbestos [11–13], or ergonomic conditions [14,15]. Although some of these risks are classified as hygienic risks and they are associated with occupational diseases, previous research [16] demonstrated that there were strong relationships between hygiene conditions and occupational accidents. They showed that poor hygienic conditions duplicate the probability of accident [16]. Majority of the previous scientific researches found about occupational health and Safety in the automotive repair and maintenance sector were located in the United States. In Europe, there is a lack of scientific publications about the topic; however, there are some professional guides about cited risks as the guide

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☆ The authors have made substantial contributions to the study in terms of concept and design, requesting accident data from the Ministry of Employment and Social Security, processing and interpreting these data using SPSS 19, and both writing and conducting critical reviews of the article. They also approved the final version.

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proposed by the Health and Safety Executive [17], and the training guide for assessing the risk in cars repair workshops [18] proposed in the TRIA project, coordinated by Cyprus Workers' Confederation. In Spain, there are more examples of risk assessment guides, such as that edited by the Centro de Experimentación y Seguridad Vial MAPFRE (CESVIMAP) [19], or the manual proposed by the Instituto Nacional de Seguridad e Higiene en el Trabajo (INSHT) [20].

It is remarkable that the Spanish Ministry of Employment registered 89,954 occupational accidents in the sector over the 2003 to 2008 period, leading to varying degrees of injury. Therefore, accidents in the sector are not a minor problem. Although it was not possible to obtain the disaggregate data of accidents the sector in order to calculate specific incidence rates, only the total number of accidents should be a reason to study and address the problem of the accidents in this sector more deeply.

The aim of this study is to analyze the effects of the factors associated with different types of injury (superficial wounds; dislocations and sprains; bone fractures; concussion and internal injuries; burns, scalding, and freezing) caused by occupational accidents in automotive repair workshops.

2. Materials and methods

2.1. Data collection of accident reports

Since 2003, it has been mandatory in Spain to register online all occupational accidents resulting in sick leave lasting 1 day or more (ORDER TAS/2926/2002, of November 19, establishing the new models for notifying occupational accidents and enabling these to be transmitted electronically). Accidents must be reported over the Delt@ electronic system by filling in an Official Occupational Accident Report. For the purpose of this study, the Ministry of Employment and Social Security provided us with 89,954 occupational accident reports corresponding to all the accidents reported from the automotive repair and maintenance sector (Classification of Economic Activities) between 2003 and 2008. This number represents the total amount of accidents reported in Spain in the cited period. Before 2003, not all accidents were reported digitally using the electronic system Delt@, because it was possible to report the accident alternatively using the official hard copy form. After 2008, Spanish Classification of Economic Activities codes were modified. Although cited codes changed, the majority of maintenance activities are similar in current times, and mechanical configuration of automobiles have not changed substantially. Cars with emergent technologies only represent a small percentage of the total vehicle population in Spain. A proof of that is that only 2% of new cars sold in 2015 in the country were hybrid or electrics [21]. Also, emergent technologies do not affect maintenance of common elements as tires or bodywork. These are the main reasons for the period studied being limited to between 2003 and 2008.

The Ministry removed all personal data from the accident reports. Despite the statutory obligation to report accidents, some might not have been notified as required by prevailing regulations, leaving them with no official record.

2.2. Study variables

We used the *injury description code* variable, based on the first two digits of the main injury groups listed in accident reports, in order to measure the effect of different variables on different types of injury. The percentages of workers injured based on the description of the injury was as follows: superficial wounds and injuries (41.2%); dislocations, sprains, and strains (38.8%); bone fractures (6.2%); concussion and internal injuries (5.3%); and burns, scalding, and freezing (2.0%). Injuries accounting for less than 2% of the total number of accidents were not analyzed. Overall, the percentage of injury descriptions studied encompassed 93.5% of all accidents.

Once the accidents had been grouped by injury description, different variables were chosen to determine how they affected different types of accident. The selection of the variables was based on the research conducted by Camino López et al [6]. In a preliminary approach we analyzed all variables ($n = 57$) included in the accidents records elaborating their contingency tables. Variables for which the majority of values in their contingency tables did not reach a statistical significance were rejected for current research. Finally, we chose the 11 variables which were statistically superior.

The variables studied were subdivided into three groups, according to whether they were worker, company, or accident description variables.

- Worker variables: Describe the profile of the injured worker. This group includes the variables sex, nationality, and employment situation (employed by a company vs. others, such as self-employment, or other special regimes).
- Company variables: Describe organizational aspects of the company. This group includes the size of the company (workforce), whether it conducts compulsory general risks assessments, its health and safety organization (outsourced prevention service or other prevention management system), and whether it worker who suffered the accident was recruited through temporary employment agencies.
- Accident description variables: Include variables related to the circumstances under which the accident occurred, such as whether it occurred in the worker's usual workplace, if more than one worker was affected, if accident occurred on Monday or not, or whether the worker was performing their usual job at the time of the accident.

2.3. Statistical analysis

Logistic regression model is a methodology used frequently in cohort studies and clinical trials. The model provides the odds ratios (ORs) for the disease or injury in those individuals who have suffered exposure to some specific variable with respect to those individuals who have not been exposed [22]. In the current research, the strength of relationship between the variables and the type of injury was measured using adjusted ORs and their 95% confidence intervals (CI). Independency of each variable was tested using Chi-square test. The data were analyzed statistically using SPSS version 19 (SPSS, Chicago, IL, USA).

3. Results

Results obtained are shown in Tables 1 and 2. In the following subsections the most remarkable results are highlighted.

3.1. Superficial wounds

Superficial wounds were significantly and independently associated with male sex (OR = 2.206; 95% CI, 2.02–2.409), with workers employed by companies (OR = 1.306; 95% CI, 1.143–1.491), with companies that used temporary employment agencies (OR = 1.885; 95% CI, 1.113–3.192), with the usual workplace (OR = 2.055; 95% CI, 1.965–2.149), and with the usual job (OR = 1.55; 95% CI, 1.472–1.633). It is also remarkable that accidents with more than one worker affected were significantly and