

# Injury analysis of teachers' occupational accidents

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## Abstract.

**BACKGROUND:** Occupational accidents among teachers are a cause of concern because of their consequences regarding several parts of the body, such as the neck, back, or extremities; however, the number of studies on this issue is limited.

**OBJECTIVE:** To analyze the possible effects of different variables (gender, age, nationality, experience, sector, day of the week, traffic accidents) associated with occupational injuries suffered by teachers.

**METHODS:** All teachers' accidents recorded in Spain (136,702) from 2003 to 2018 were analyzed. Odds ratios with a 95% confidence interval were calculated.

**RESULTS:** For injured female workers, being younger than 45, in her first month of experience, in a public school, without risk assessment, and in a traffic accident are the most important factors related to suffering a neck injury. In the case of injured male workers, to be older than 45, in a private school, and no traffic accidents are the factors detected influence suffering an injury in lower extremities.

**CONCLUSIONS:** Institutions and schools should pay special attention to the highest-risk profiles. Results obtained can be a very useful tool for the design and implementation of specific occupational health and safety strategies adapted to the more vulnerable workers in each kind of injury.

Keywords: Injury, neck, occupational accident, risk, teacher

## 1. Introduction

Occupational injuries represent an important problem in working populations, due to their negative consequences on workers, companies, and society [1]. Injuries suffered at work are a common cause of sick leave, absenteeism, economic compensations, and early retirement. Depending on their working tasks, some professionals are more probably to suffer occupational injuries. In the case of the teaching profession, repetitive postures, writing on a blackboard,

or “head down” reading or writing are a frequent cause of pain and injuries [2]. Currently, the number of teachers around the world is estimated at around 90 million, and 69 million more should be recruited before 2030 to provide every child primary and secondary education [3]. In Spain alone, 874,998 teachers were working during 2018 at the primary and secondary levels [4]; in the US, this number increased to 3.7 million teachers in 2019 [5]. Then, considering the total number of teachers exposed to some specific occupational risks, their occupational injuries cannot be undervalued and they should be studied in depth.

In the literature, some studies can be found concerning teachers' injuries at workplaces in different countries, such as the US [6], China [7], Spain [8],

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Belgium [9], Saudi Arabia [10], and Taiwan [11]. Many of the studies are focused on musculoskeletal disorders (MSD) among teachers. This fact has motivated relevant reviews about this issue [1, 12], and several factors have been correlated with the incidence of MSD in teachers. Some of these include posture at work, excessive paperwork, students' demands, lack of communication, and poor colleague and supervisor support [1]. Another prevalent factor identified in MSD among teachers was depression [13].

The majority of research available was classified according to the teaching specialty or part of the body affected.

In the first classification, several studies were undertaken related to music teachers [14–17] and physical education teachers [18–20]. Musicians spend many hours of practice time per week, and awkward body positions mandated by the shape and weight of the instrument, or the technical difficulty of the repertoire, can contribute to injuries [15]. In the case of physical education teachers, their injuries are caused by prolonged standing and walking, demonstrating sports techniques, assisting students, lifting and carrying heavy loads [20].

In the latter, the existing literature studied the different parts of the body affected when a teacher suffered an injury [1]. Several authors conducted studies focused on teachers and considered their injuries in their necks [21–23], back [24–26], upper extremities [7, 26] or lower extremities [27, 28].

In the cited previous research, different methodologies were used to address the problem of occupational injuries suffered by teachers. Some studies carried out surveys based on questionnaires about the topic [21, 25–27] or developed focus groups [16], while other authors analyzed a limited quantity of accident data [17, 27, 28].

In spite of the high number of workers in the education sector and their important presence in our society, the number of studies about occupational accidents is limited when compared with other sectors traditionally considered hazardous, such as construction [29] or manufacturing [30]. Similarly to previous research developed in other sectors and professions, it is important to study the evolution of occupational injuries over time. The different personal characteristics of teachers related to their injuries should be identified and analyzed in order to improve the preventive measures in schools according to the prevalence of the different factors identified. In consequence, the current research objective is to analyze

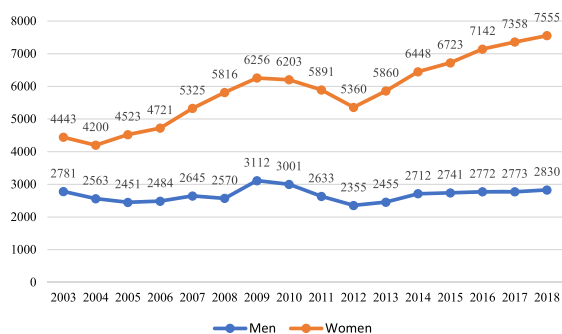


Fig. 1. Accidents reported by year and sex.

the possible effects of some variables associated with different injuries suffered by teachers due to their occupation. With this aim, a total number of 136,702 occupational accidents suffered by teachers over a period of 16 years were analyzed.

## 2. Methodology

In order to describe the population studied and their labor conditions, some relevant data were collected. In Spain, 874,998 teachers were working during 2018. The student to teacher ratio was 14 in primary school and 11 in secondary school, while the total hours spent at the workplace in the academic year was more than 800 at the primary and more than 700 at the secondary level [31]. A teacher's job does not only consist of teaching in the classroom; other activities such as reviewing students' homework, supervising students, attendance at management meetings or at training programs are examples of typical tasks carried out each year.

### 2.1. Data collection from accident reports

According to Spanish legislation, all occupational accidents resulting in sick leave lasting one day or more should be reported electronically. Platform Delt@ is the electronic system available to fill in the Official Occupational Accident Report. For the current research, the Ministry of Labor, Migrations and Social Security supplied us with 136,702 occupational accident reports corresponding to all accidents reported by teachers in the education sector (primary school, secondary school, high school, university, vocational training, and special education) from 2003 until 2018. Reports were previously anonymized by the Ministry, removing data such as the name of the worker or organization.

Table 1  
Incidence rate per 1000 workers by gender

Year	Men incidence rate per 1000 workers	Women incidence rate per 1000 workers
2003	13,37	11,48
2004	12,11	10,50
2005	11,64	10,95
2006	11,54	10,91
2007	12,14	11,70
2008	11,53	12,14
2009	13,98	12,86
2010	13,49	12,46
2011	11,77	11,59
2012	10,95	10,79
2013	11,44	11,63
2014	12,64	12,72
2015	12,51	12,97
2016	12,75	13,72
2017	12,59	13,84
2018	12,62	13,86

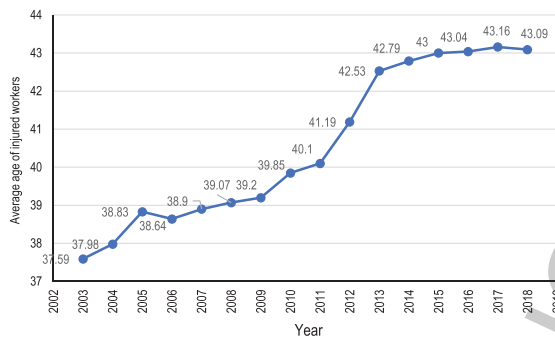


Fig. 2. Evolution of average age of injured workers per year.

Although notification is compulsory, an unknown number of accidents were able to be hidden from the government or to go unreported. The total number of accidents suffered and reported by women in the last years increased, while in the case of men, their figures did not change significantly. Incidence rates calculated showed similar trends (Table 1). Regarding the age of injured workers, the evolution of their average age is noteworthy, as it increased annually from 37.59 years in 2003 to 43.09 years in 2018 (Fig. 2).

## 2.2. Accident report variables

The variable *part of the body injured* was selected to measure the effects of different variables on different parts of the anatomy affected. Percentages of workers injured based on the cited variable are described in Fig. 3.

Once the accidents were grouped by part of the body affected, different variables were selected to

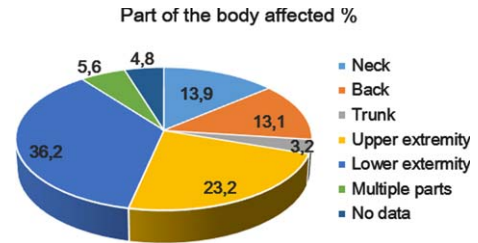


Fig. 3. Distribution of part of the body affected.

analyze how they affected the accidents. The selection of variables was based on a previous research [32]. In a first approach, all variables included in official accident reports were analyzed ( $n = 58$ ). After that, variables with higher statistical significance were selected.

Variables were classified into the following three groups:

- **Personal variables** describe the personal profile of the worker injured (sex, nationality, age, length of service)
- **Company variables** describe organizational characteristics of the business. In this category, sector group, risk assessment, and occupational health and safety organization (outsourced or own service) were included.
- **Accident description variable** includes variables about the circumstances of the accident. In this category, whether the accident was on Monday or not, and whether it was a traffic accident was considered.

## 2.3. Statistical analysis

Odds ratio values based on logistic regression model were calculated [33]. The strength of the relationship between variables studied and the injury description were measured using an adjusted odds ratio with a confidence interval of 95 per cent. Analysis was conducted using the software Statistical Package for Social Science SPSS version 25.

## 3. Results

MSD injuries are the result of the interaction between the affected worker and his risk factor variables, such as gender, age, or experience. The influence of the main variables selected and studied is shown in Table 2.

Table 2  
Injury odds ratio based on main accident variables

Variable	Variable values	Neck	Back	Trunk	Upper—extremity	Lower—extremity	Multiple parts
Sex	Male	0.554*	0.918	1.410*	1.212*	1.068*	0.866*
	Female	1	1	1	1	1	1
Nationality	Spanish	1.707*	0.933	1.056	0.823*	0.983*	1.073
	Others	1	1	1	1	1	1
Age	less 30	1.643*	0.953*	0.596*	0.996	0.825*	0.937*
	30 and older	1	1	1	1	1	1
Age	less 45	2.796*	1.105*	0.572*	0.742*	0.843*	0.930*
	45 and older	1	1	1	1	1	1
Length	1–31 days	1.192*	0.777*	0.950	0.985	1.001	1.120*
	Rest	1	1	1	1	1	1
Length	first month	1.329*	0.938*	0.848*	1.019*	0.873*	0.993
	Rest	1	1	1	1	1	1
Sector	Private	0.956*	1.115*	0.916*	0.991	1.086*	0.775*
	Public	1	1	1	1	1	1
Risk assessment	No	0.879*	1.136*	0.976	1.089*	1.020	0.778*
	Yes	1	1	1	1	1	1
Monday	Yes	0.933*	1.238*	1.028	0.941*	0.990	0.978
	No	1	1	1	1	1	1
Traffic	No	0.04*	1.359*	1.209*	5.135*	7.677*	0.224*
	Yes	1	1	1	1	1	1

\*Significant at 95% CI.

### 3.1. Neck injuries

Neck injuries were significantly and independently associated with Spanish nationality (OR = 1.707; 95% CI = 1.563–1.865), being younger than 45 years of age (OR = 2.796; 95% CI = 2.696–2.900), having less than a year of experience (OR = 1.329; 95% CI = 1.288–1.371), and the absence of risk assessment (OR = 1.396; 95% CI = 1.353–1.440). In contrast, male gender (OR = 0.554; 95% CI = 0.534–0.575) and no traffic accidents (OR = 0.04; 95% CI = 0.039–0.042) were significantly and independently associated with a lower probability of neck injuries.

### 3.2. Back injuries

Back injuries were statistically significantly and independently associated with being younger than 45 years of age (OR = 1.105; 95% CI = 1.070–1.142), in the private sector (OR = 1.115; 95% CI = 0.077–1.154), a lack of own prevention service (OR = 1.136; 95% CI = 1.097–1.177), accidents on Mondays (OR = 1.238; 95% CI = 1.194–1.284), and traffic accidents (OR = 1.359; 95% CI = 1.301–1.419). Remarkably, younger than 30 years of age (OR = 0.953; 95% CI = 0.916–0.991) and being a worker in the first month of employment (OR = 0.871; 95% CI = 0.844–0.899) were found as protective factors with respect to this kind of injury.

### 3.3. Trunk injuries

In this category were included injuries to the chest and internal organs, such as the heart, stomach, or lungs. The factors male gender (OR = 1.410; 95% CI = 1.326–1.500) and no traffic accidents (OR = 1.209; 95% CI = 1.115–1.311) were significantly and independently associated with trunk injuries. In the opposite sense, being younger than 45 years of age (OR = 0.572; 95% CI = 0.539–0.607) and having work experience shorter than one year (OR = 0.848; 95% CI = 0.796–0.903) were revealed as protective factors in accidents studied.

### 3.4. Upper extremity injuries

In the case of accidents with upper extremity injuries, statistically significantly and independent associations were found between males (OR = 1.212; 95% CI = 1.180–1.245) and no traffic accidents (OR = 5.135; 95% CI = 4.882–5.400). In contrast, if an accident was suffered by a worker with Spanish nationality (OR = 0.823; 95% CI = 0.777–0.872) on a Monday (OR = 0.941; 95% CI = 0.913–0.970), the probability of the injury being located in the upper extremity was lower.

### 3.5. Lower extremity injuries

Injuries to the lower extremities showed some similarities with injuries to the upper extremities. Male

Table 3  
Protective effects of variables on type of injury

Variable	Variable values	Neck	Back	Trunk	Upper extremity	Lower extremity	Multiple parts
Sex	Male	Prot	N.S	Risk	Risk	Risk	Prot
	Female	Risk	N.S	Prot	Prot	Prot	Risk
Nationality	Spanish	Risk	N.S	N.S	Prot	N.S	N.S
	Others	Prot	N.S	N.S	Risk	N.S	N.S
Age	less 30	Risk	Prot	Prot	N.S	Prot	Prot
	30 and older	Prot	Risk	Risk	N.S	Risk	Risk
Age	less 45	Risk	Risk	Prot	Prot	Prot	Prot
	45 and older	Prot	Prot	Risk	Risk	Risk	Risk
Lenght	1–31 days	Risk	Prot	N.S	N.S	N.S	Risk
	Rest	Prot	Risk	N.S	N.S	N.S	Prot
Lenght	first month	Risk	Prot	Prot	N.S	Prot	N.S
	Rest	Prot	Risk	Risk	N.S	Risk	N.S
Sector	Private	Prot	Risk	Prot	N.S	Risk	Prot
	Public	Risk	Prot	Risk	N.S	Prot	Risk
R.Assesm	No	Risk	Prot	N.S	Risk	N.S	Prot
	Yes	Prot	Risk	N.S	Prot	N.S	Risk
Monday	Yes	Prot	Risk	N.S	Prot	N.S	N.S
	No	Risk	Prot	N.S	Risk	N.S	N.S
Traffic	No	Prot	Risk	Risk	Risk	Risk	Prot
	Yes	Risk	Prot	Prot	Prot	Prot	Risk

Prot = Protective; N.S = Not significant.

gender (OR = 1.068; 95% CI = 1.034–1.094) and no traffic accidents were detected as factors that were both independently associated and statistically significant. However, other variables such as nationality, experience, or risk assessment did not show relevant results related to the cited injury because the odds ratios obtained were not significant for the confidence intervals that were calculated.

### 3.6. Multiple injuries

It is remarkable that the absence of risk assessment was statistically significant in accidents with multiple injuries (OR = 1.241; 95% CI = 1.185–1.300). It should be highlighted that no traffic accidents obtained the lowest OR value for this kind of injury (OR = 0.224; 95% CI = 0.214–0.235).

## 4. Discussion

In Table 3, the protective or risk-related influence of the variables analyzed for each type of injury are summarized. It is remarkable that a variable that acts as a protective factor for all injuries identified was not found.

With regard to the gender of the injured teachers, female sex was a risk factor for suffering a neck or multiple injuries, while it was a protective factor against injuries to the trunk and extremities. Aligned

with these results related to neck injuries, female teachers obtained a high risk odds ratio related to neck pain in Turkish schools (OR = 1.54; CI = 1.03–2.31) [34] and in Chinese secondary schools (OR = 2.39; CI = 1.97–2.91) [2]. Similarly, in previous research, female teachers reported significantly more symptoms related to the neck than male teachers [35], and the female gender was significantly associated with neck pain [7]. It was demonstrated that neck pain in female teachers can be reduced by carrying out interventions based on on-site ergonomics training, workers' information brochures, and posters, all of which showed a positive effect on preventing neck injuries [22].

With regard to the nationality of teachers, although migrant workers in the majority of sectors are more vulnerable to occupational injuries [36, 37], in the specific occupation of teacher, the nationality factor was not found to be significant in the majority of injuries. Otherwise, being a migrant worker was pointed out as a protective factor against neck injuries.

With regard to the age factor, this has been studied previously in other research. The age range between 40 and 49 years was the most prevalent age group [38]; however, other authors considered a wider range of ages from 35 to 50 years [39]. Although the prevalence data are very useful, it is also important to know the probability of each injury once the accident has happened, considering the age of the workers. The

findings of this study suggested that injured workers younger than 30 were more likely to suffer a neck injury. In the case of teachers younger than 45, that probability increased.

In terms of experience, teachers who suffered an accident in their first month of service were more likely to suffer a neck injury. This fact can be justified because they are in an adaptation period with a high level of psychosocial risk demand [40]. Another reason could be the poor quality of sleep due to adapting to a new school [41].

After comparing public schools with private schools, the main difference was that multiple body part injuries were more probable in accidents suffered by workers from public schools. Considering that multiple body part injuries were associated with traffic accidents, the results seem to suggest that teachers from public schools were more likely to suffer traffic accidents. In Spain, teachers in public schools are possible to change their workplace each year, then the mobility is especially high, and car travels are very frequent. Lack of mobility programs in the sector should be addressed promoting public strategies and interventions for drivers.

The Monday effect happens when a worker claims that accidents that occurred over the weekend outside working hours are occupational accidents [42]. In some industrial sectors, this syndrome has been detected [43, 44]. It is remarkable that Monday was detected as a risk factor for back injuries but not for the rest of the injuries analyzed. These results suggest that the cited Monday effect could be hidden in some occupational back injuries.

Traffic accidents were shown to be as risk factor for neck and multiple body part injuries. This seems to be logical since the majority of damage produced in a traffic accident is associated with these types of injuries. In that sense, it is demonstrated that whiplash injuries are among the leading injuries related to car crashes [45]. The decrease of occupational traffic accidents is complex because several factors are linked with them. However, preventive measures focused on working factors as burnout could reduce the number of traffic accidents and their injuries associated [46].

Despite on majority of injuries were classified as light injuries, inadequate or improper rehabilitation, and the overuse of injured part, could aggravating the damage, and increase the prevalence of future similar injuries [47]. Then it is very important to promote interventions based on occupational health and safety education, work organization, and on-site

ergonomics training, due to their positive results in previous experiences [48]. Performed interventions in other countries helped teacher to improve their level of understanding of injury, and introduced behavioral and attitude changes related with optimal postures, work schedule, and stretching routines.

## 5. Conclusions

According to the results obtained, the main risk factors can be pointed out once the accident has happened. In the group of injured females, to be Spanish, younger than 45 years of age, in the first month of work experience, in a public school, without risk assessment, and in a traffic accident are the most important factors related to suffering a neck injury.

In the case of injured male workers, to be older than 45 year of age, in a private school, and in no traffic accidents are the most influential factors detected for suffering an injury to the lower extremities.

Institutions and schools should pay special attention to the highest risk profiles. Results obtained can be a very useful tool for the design and implementation of specific occupational health and safety strategies adapted to the workers most vulnerable to each kind of injury. Some solutions could be specific training programs adapted to the teacher's profile, ergonomics intervention on site, psychosocial support from managers, and adaptation of workload demand.

### 5.1. Limitations

No primary data was collected for the current study, then only a secondary data analysis was performed. Secondary data have some advantages as availability, completeness, access or cost, and some disadvantages as lack of specific research questions, or incomplete information. Although the current study is based on official data from all accidents suffered by teachers in Spain over a period of 16 years, only variables included in the official form were analyzed. Some additional factors could affect the circumstances of the accident, but if they were not considered as a variable in the official form, they were not evaluated. Additionally, incidents or accidents not reported to the government were not studied because there were no records of them.

### 5.2. Future research

The relationship between occupational traffic accidents and other risk factors should be studied in

a more focused study of these kinds of accidents because data seem to point to some similarities with other risk factors such as gender, experience, or age. Additionally, the design and development of specific preventive programs would be important in order to protect every worker according to the prevalence of risk factors identified. In this sense, it would be desirable to implement the protective measures and to obtain feedback on their effectiveness through injuries statistics and workers' questionnaire. Another important research challenge is the integration of primary and secondary data focused on teachers' occupational accidents.

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### Conflict of interest

None to report.

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