

Organisational and personal factors in occupational traffic injuries at work in Spain

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Abstract

Objective: Traffic crashes are one of the major causes of deaths at work. However, most of the literature on traffic crashes did not study the influence of worker and organisation conditions. The current paper analyses the influence of the personal and organisational factors associated with the severity of occupational traffic crashes.

Methods: A total of 724,596 occupational traffic crashes that occurred in Spain from 2009 to 2019 were analysed. Men suffered 59% of crashes registered, while workers younger than 30 represented 31.3% of crashes studied. Variables included in the Official Occupational Accident Report were analysed using logistic regression calculating odds ratios.

Results: Results showed that a foreign, professional male driver from a small company who is older than 55 years was more likely to suffer a fatal crash. In contrast, a Spanish, non-professional female driver from a medium or big company who is younger than 30 years is more likely to suffer light consequences.

Conclusions: Findings from the current research could help to improve the safety training programmes in companies considering their personal and business variables such as age, gender, or company staff, especially in small companies. Future research should collect and analyse additional variables combining different data sources.

Keywords: occupational, traffic, crash, driver, injury, severity

Introduction

Traffic is one of the major causes of accidental deaths at work around the world (WHO, 2018). Several authors have studied the problem in different countries, including Finland, the United States of America, Spain, the United Kingdom, Australia, and Norway (Al-Balbissi 2003; Doroudgar et al. 2017). The exposure to the risk of traffic crashes going to or from home to the workplace is daily for the majority of workers. In the case of professional drivers, their exposure continues during their working hours. Traffic crashes represent around 20–40% of occupational crashes in industrial countries (Fort et al. 2010), but there is a lack of specific work-related risk factors in traffic crashes. Different influence factors have been previously studied, such as characteristics of the vehicles involved (Mitchell et al. 2004), use of safety equipment like seat belts (Fort et al. 2013), age of the driver (Charbotel et al. 2010), or psychosocial working conditions (Fort et al. 2016). Few studies have focused on organisational factors and framework conditions of traffic crashes at work (Camino López et al. 2017). One study suggested that commuting accidents involving professional drivers differ in demographic and situational issues from general and on-duty professional drivers' traffic crashes (Llamazares et al. 2019), while another study noted that commuting-related accident rates were higher among women than men (Camino López et al. 2017). To complete the existing background, better knowledge of personal and organisational factors of occupational crashes is needed. The aim of the current paper is to analyse the influence of the personal and organisational variables associated with the severity of occupational traffic crashes.

Methodology

Data collection

In Spain, it is mandatory to register online all workplace crashes resulting in one day or more of

absence from work. Crashes should be notified to the labour authority through the Delt@ electronic system by filing an official report. Due to the representativeness and the high number of accidents that are reported daily through the electronic application, several researchers have used accident data from the Delt@ system to carry out their work in both the field of occupational accidents (López-Arquillos et al. 2015) and the field of occupational traffic crashes (Camino López et al. 2017). In Spain, 6,591,775 occupational accidents were reported from 2009 to 2019. Only 0.1% were fatal, and 99.0% of them were considered light crashes.

For the current research, the Spanish government provided us all occupational traffic crashes registered in Spain (724,596 crashes) from 2009 to 2019. They represented around 10% of the occupational crashes reported. In the case of the Spanish legal framework, crashes that occurred going to or from home to the workplace are considering occupational crashes. Men suffered 59% off crashes registered and women only 41%, while workers younger than 30 years registered 31.3% of crashes reported.

According to the data supplied and showed in Figure 1, the total number of traffic crashes decreased from 2009 to 2012 and increased from 2013 to 2019. Incidence rates of crashes per 100,000 workers were calculated using official statistics of the people employed and showed a similar trend. The increase in the total number of crashes apparently is not only affected by the increase of workers exposed.

Crashes reported were grouped by severity code (light, serious, very serious, or fatal). This classification is based on medical criteria, because Spanish health authorities must diagnose the severity of each occupational accident reported (BOE 2002). The accepted medical criteria in Spain is detailed in Table 1.

The occupational accident notification form only includes the four cited levels. An occupational crash notification form does not include another typical severity scale for traffic crashes like the Abbreviated Injury Scale (AIS), because it is considered in the Delt@ platform as a standard

occupational accident. The rest of the variables were dichotomised, when necessary, to calculate their odds ratio (OR).

The distribution of crashes based on the main variables supplied is shown in Table A1. The majority of crashes were light, suffered by males, and did not involve foreign workers. Concerning the age factor, the distribution of the crashes changed with severity. While the average of total workers injured was 36.97 years, the average age in the group of workers affected by a fatal crash was 42.09 years.

Statistical analysis

A logistic regression model is commonly used in clinical trials and cohort research. This method calculates the ORs for the disease in a sample of people who have been exposed to some specific variable compared to another sample of people not exposed. Based on ORs with a 95% confidence interval (CI), the relation between the severity of traffic crashes and different variables was analysed. OR calculation was performed successfully in recent studies focused on work traffic crashes (Useche et al. 2020).

Results

The results obtained are shown in Table A2. The most remarkable results per variable are highlighted in the following subsections.

Gender

The number of female workers in Spain is increasing every year, so it is important to provide insight into gender as a risk variable. Gender was significantly and independently associated with the severity of occupational traffic crashes, but the association changed with the severity level. On the one hand, an injured male worker is less likely to suffer a light crash (OR=0.39; 95% CI, 0.37–0.40) than a female. On the other hand, if the crash is fatal, a male is more likely to suffer

it (OR=4.98; 95% CI, 4.40–5.62).

Nationality

Regarding nationality, fatal crashes were significantly or independently associated with Spanish workers (OR=0.60; 95% CI, 0.53–0.67). A foreign worker who suffers a crash is 1.6 times more likely to be killed than a native worker. In contrast, Spanish workers are 1.3 more likely to suffer a light crash compared with foreign staff crashes.

Labour contract

Attending to the labour contract, a worker employed by companies showed a worse light accidents (OR=1.65; 95% CI, 1.50–1.81) compared with the rest of the workers (self-employed and employed by temporary work agencies). However, variable labour contract was not found significantly associated with fatal crashes.

Professional drivers

In the category of professionals drivers were included all workers categorized as drivers in the Spanish Standard Occupational Classification (SOC). For instance, bus, taxi, trucks, or lorry drivers. Although they are specially trained for driving tasks and their habitual experience on the road is important, professional drivers are more likely to suffer a fatal crash (OR=3.46; 95% CI, 3.17–3.77).

Company staff

Fatal crash rates obtained in the current research are aligned with some previous studies (OR= 1.48; 95% CI, 1.354–1.612).

Length of service

The effects of length of service on occupational accidents have been shown to be significant in hazardous sectors like construction. However, in the traffic crashes analysed, the influence of seniority of the worker was very low or not relevant.

Age

It is remarkable that while crashes among workers under 35 years old were more likely to be light (OR= 1.63; 95% CI, 1.60–1.70), crashes in the group of workers older than 55 were more likely to be serious (OR= 2.00; 95% CI, 1.89–2.12) very serious (OR= 1.96; 95% CI, 1.53–2.50) or fatal (OR= 2.42; 95% CI, 2.14–2.73).

Time of day

Regarding the hour of the crash, worse fatality results were detected in the night (OR= 2.01 ; 95% CI, 1.83–2.22).

Type of journey

Commuting accidents are considered occupational accidents in Spain, then they are legally considered as accidents that happened during the working time. They represented a high percentage of occupational crashes (72.6%). However, their odds ratio values for fatal (OR= 0.52; CI- 0.48-0.56) were lower than on mission.

Discussion

The most remarkable results per variable are discussed in the following subsections.

Gender

Results are aligned with previous studies about traffic crashes that concluded mortality is greater

among males (W. H. Organization 2018). This difference in traffic fatalities has been frequently attributed to their lower perceived risks (Hatfield & Fernandes 2009), risky behaviours (Vardaki & Yannis 2013), and the lower use of safety devices (Fernandes et al. 2010). Despite the lower severity of crashes suffered by women, they are more likely to suffer traffic-related commuting injuries than men (Camino López et al. 2017). This could be because women occupy more part-time jobs, and they dedicate more time than men to take care of their children and parents.

Nationality

A similar risk of crashes based on nationality and severity has been pointed out (Li et al., 2018). Other authors found that migrant workers have unsafe traffic behaviour and highlight the importance of traffic safety education for migrant workers (Sun & Yang 2013).

Labour contract

Although temporary workers are traditionally linked to worse accident rates and more likely to suffer severe injuries than permanent workers, in the case of an occupational traffic crash, victims were more often on permanent contracts (Fort et al. 2010). This higher mortality among those with permanent contracts could be due to a less flexible schedule and lack of flexibility in performing the work. In contrast, other authors pointed out that part-time contracts appear to be linked to a higher incidence injury rate, especially in commuting injuries among women (Camino López et al. 2017).

Professional drivers

Similarly, in research conducted in France, it was observed that professional drivers still had the highest risk of crashes while at work (Charbotel et al. 2010). Due to particular working conditions such as long driving periods or shift work, professional drivers can suffer high levels of stress at work, which sometimes are associated with risky behaviours like alcohol and drug use (Herrero

et al. 2017). Other intrinsic factors of crashes in the group of professional drivers were found by other authors like lower education level, higher discomfort levels, and bad fatigue management (Fort et al. 2010).

Company staff

The size of the company is highlighted in the literature as an important factor related to occupational accidents. Safety management systems were sometimes found to be lacking in smaller companies when compared with larger companies. In the case of traffic risks, the problem is similar (Fort et al., 2016), and road crash victims are more likely to be in smaller companies (OR=2.24; 95% CI, 1.31–3.85) (Fort et al. 2010). Due to the association of the company staff with other factors as type of job, tasks distributions, human and economic resources or OHS management, further research is needed to a better understanding of company staff variable.

Length of service

A similar study carried on in another country concluded that seniority in the job showed no effect (Fort et al. 2010).

Age

These result are aligned with previous results which concluded that the incidence of severe injury among elderly patients was nearly 1.6 times higher than that of non-elderly patients (Kong et al. 2018). Younger drivers demonstrate lower risk aversion and a higher propensity for taking accident risks compared to older drivers, but the complexity of the problem is not limited to risk perception in the case of fatal crashes. Some authors suggested that frailty or pre-existing health conditions play a great role in increasing the severity of traffic crashes in older drivers (Boufous & Williamson 2009). Other authors pointed that older drivers experience significantly slower reaction times compared to younger drivers (Doroudgar et al. 2017). According to the different

factors associated with age variable, a further multivariate analysis should be performed for age of the driver in occupational traffic crashes.

Time of day

These results can be due to reasons such as the combination of alcohol and sleepiness or worse lighting and weather conditions. Other risk factors such as fatigue, sleep disorders, or shift work are linked to night traffic accidents, especially among professional drivers (Herrero et al. 2017). Aligned with the results obtained, other authors concluded that drivers are more likely to die at night time (Stimpson et al. 2013).

Type of journey

These results could be influenced by type of vehicle, extended shift works, time pressure at work, or inflexible schedule (Fort et al. 2010). In addition, driving a vehicle not belonging to the driver was identified as another important factor for on-duty crashes (Fort et al. 2013).

It can be concluded that personal and organisational variables related to workers and companies analysed showed different influence levels on the traffic crashes studied. Some showed similarities with traffic crashes in general, not only at work, like gender, nationality, age of the driver, or hour of the crash. Men and women showed very different rates; thus, preventive measures should be adapted to the results obtained.

In addition, specific variables related to organisations and working conditions showed that the size of the company, length of service, or type of contract should be considered by authorities and companies to reduce the consequence of occupational traffic crashes. The problem of fatal crashes in small companies is remarkable; however, their economic and human resources are a complex barrier for some of the possible solutions. In that case, institutional safety training or a tax rewarding system for small safety companies could be explored as possible safety

interventions.

Special efforts should be carried out by every stakeholder to reduce the human and economic costs of working days lost, which numbered a total of 21,159,622 absence days, with an average of 1,923,602 absence days per year in the period studied.

The majority of current preventive measures are focused on reducing crashes and risk behaviours through occupational health and safety management systems based on safety training and education and safety promotion. However, many safety training programmes are generic and not adapted enough to the personal variables of each company. Results obtained in the current research could help to improve the safety training programmes in companies considering their personal and business variables like age, gender, or company staff. Mobility plans integrated into the OHS management of the companies should be promoted by companies and institutions, especially in small companies that had the worst severity rates.

Limitations of the study

Although the sample analysed was statistically tested and includes many relevant variables, some specific issues point to potential limitations. The first one was that results and discussion were based on unvariable analyses. The second one was the sample represented all occupational crashes reported in Spain in the period studied; however, unreported crashes were not studied. Similarly, crashes that occurred but were not reported as an occupational traffic crash were not included in the data supplied; as a result, they could not be considered. Variables included in the official notification of the crashes at work analysed do not include some important variables in traffic crashes, such as the type of vehicle, road category, or weather conditions. The available information analysed is limited when compared with full traffic crash reports by authorities after a serious crash. Official crash reports should include additional fields and variables for a better understanding of the circumstances of the occupational traffic crash. In contrast, not only fully

investigated crashes were included, all crashes reported could be analysed, independently if the crash was fully investigated due to its severity serious or fatal. Another limitation of the current study and similar studies is the lack of accurate data about the exposure time of drivers on the road, especially when they are not professional drivers. Similarly, working conditions of the injured worker are rarely researched, such as task demand, mental fatigue, or concentration.

The majority of previous studies identified limitations in the data analysed, due to the lack of relevant information in the accident report. To address the limitations of the information contained in the existing database, coordinated study of the occupational crashes using multiple data sources could improve the current results. One example could be the comparison of crashes registered by traffic authorities and crashes reported to the labour authorities. Additional information could be collected through the development of an occupational mobility survey. In the past, relevant examples were carried on in Spain (Ministerio de Fomento. Gobierno de España 2007), but existing reports focused on the topic are not updated. The survey's information could fill the gap of the available database. The development of specific preventive strategies to mitigate the negative influence of the variables and the effectiveness of the proposed measures should be studied in future research.

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References

- Al-Balbissi AH. 2003. Role of gender in road accidents. *Traffic Inj Prev.* 4(1):64–73.
- BOE. 2002. Orden TAS/2926/2002, de 19 de noviembre, por la que se establecen nuevos modelos para la notificación de los accidentes de trabajo y se posibilita su transmisión por procedimiento electrónico. BOE [Internet]. [accessed 2021 Jan 20]:40988–41013. <https://www.boe.es/eli/es/o/2002/11/19/tas2926>

- Boufous S, Williamson A. 2009. Factors affecting the severity of work related traffic crashes in drivers receiving a worker's compensation claim. *Accid Anal Prev.* 41(3):467–473.
- Camino López MA, González Alcántara ÓJ, Fontaneda I. 2017. Gender differences in commuting injuries in Spain and their impact on injury prevention. *Biomed Res Int [Internet]*. 2017:1–11. <https://www.hindawi.com/journals/bmri/2017/3834827/>
- Charbotel B, Martin JL, Chiron M. 2010. Work-related versus non-work-related road accidents, developments in the last decade in France. *Accid Anal Prev.* 42(2):604–611.
- Doroudgar S, Chuang HM, Perry PJ, Thomas K, Bohnert K, Canedo J. 2017. Driving performance comparing older versus younger drivers. *Traffic Inj Prev.* 18(1).
- Fernandes R, Hatfield J, Soames Job RF. 2010. A systematic investigation of the differential predictors for speeding, drink-driving, driving while fatigued, and not wearing a seat belt, among young drivers. *Transp Res Part F Traffic Psychol Behav.* 13(3):179–196.
- Fontaneda I, Camino López MA, González Alcántara OJ, Ritzel DO. 2019. Gender differences in lost work days due to occupational accidents. *Saf Sci.* 114:23–29.
- Fort E, Chiron M, Davezies P, Bergeret A, Charbotel B. 2013. Driving Behaviors and On-Duty Road Accidents: A French Case-Control Study. *Traffic Inj Prev.* 14(4):353–359.
- Fort E, Ndagire S, Gadegbeku B, Hours M, Charbotel B. 2016. Working conditions and occupational risk exposure in employees driving for work. *Accid Anal Prev.* 89:118–127.
- Fort E, Pourcel L, Davezies P, Renaux C, Chiron M, Charbotel B. 2010. Road accidents, an occupational risk. *Saf Sci [Internet]*. 48(10):1412–1420. <https://linkinghub.elsevier.com/retrieve/pii/S0925753510001608>
- Hatfield J, Fernandes R. 2009. The role of risk-propensity in the risky driving of younger drivers. *Accid Anal Prev.* 41(1):25–35.
- Herrero MJ, Domingo-Salvany A, de la Torre R. 2017. Data from roadside screening for psychoactive substances, alcohol and illicit drugs, among Spanish drivers in 2015. *Data Br.* 15:160–162.
- Kong JS, Hyun Kim O, Youk H, Young Lee H, Young Kang C, Sung S, Yun Jang J, Yoon TW,

Hyun Lee K. 2018. Analysis of injury mechanism of the elderly and non-elderly groups in minor motor vehicle accidents. *Traffic Inj Prev.* 19(sup2).

Li Y, Yamamoto T, Zhang G. 2018. Understanding factors associated with misclassification of fatigue-related accidents in police record. *J Safety Res.* 64:155–162.

Llamazares J, Useche SA, Montoro L, Alonso F. 2019. Commuting accidents of Spanish professional drivers: when occupational risk exceeds the workplace. *Int J Occup Saf Ergon.*

López-Arquillos A, Rubio-Romero JC, Gibb A. 2015. Accident data study of concrete construction companies' similarities and differences between qualified and non-qualified workers in Spain. *Int J Occup Saf Ergon.* 21(4).

Ministerio de Fomento. Gobierno de España. 2007. Movilia 2006/2007 | Ministerio de Fomento. Encuesta Movil las Pers Resid en España [Internet]. [accessed 2019 Dec 4]. <https://www.fomento.gob.es/informacion-para-el-ciudadano/informacion-estadistica/movilidad/movilia-20062007/encuesta-de-movilidad-de-las-personas-residentes-en-espana-movilia-20062007>

Mitchell R, Driscoll T, Healey S. 2004. Work-related road fatalities in Australia. *Accid Anal Prev.* 36(5):851–860.

Stimpson JP, Wilson FA, Muelleman RL. 2013. Fatalities of pedestrians, bicycle riders, and motorists due to distracted driving motor vehicle crashes in the U.S., 2005-2010. *Public Health Rep.* 128(6):436–442.

Sun H, Yang D. 2013. Traffic Safety Knowledge Survey and Difference Analysis for Migrant Workers. *Procedia - Soc Behav Sci.* 96:2187–2193.

Useche SA, Cendales B, Alonso F, Montoro L. 2020. Multidimensional prediction of work traffic crashes among Spanish professional drivers in cargo and passenger transportation. *Int J Occup Saf Ergon* [Internet].:1–8. <https://www.tandfonline.com/doi/full/10.1080/10803548.2020.1732102>

Vardaki S, Yannis G. 2013. Investigating the self-reported behavior of drivers and their attitudes to traffic violations. *J Safety Res.* 46:1–11.

W. H. Organization. 2018. WHO global status report on road safety 2018. World Heal Organ

[Internet]. [accessed 2020 Oct 19] ادعلا (1):43. http://www.who.int/violence_injury_prevention/road_safety_status/2018/en/%0Ahttp://www.who.int/violence_injury_prevention/road_safety_status/2018/en/%0Ahttps://repositorio.ufsc.br/bitstream/handle/123456789/186602/PPAU0156-D.pdf?sequence=-1&isAllowed=y%25

FIGURE

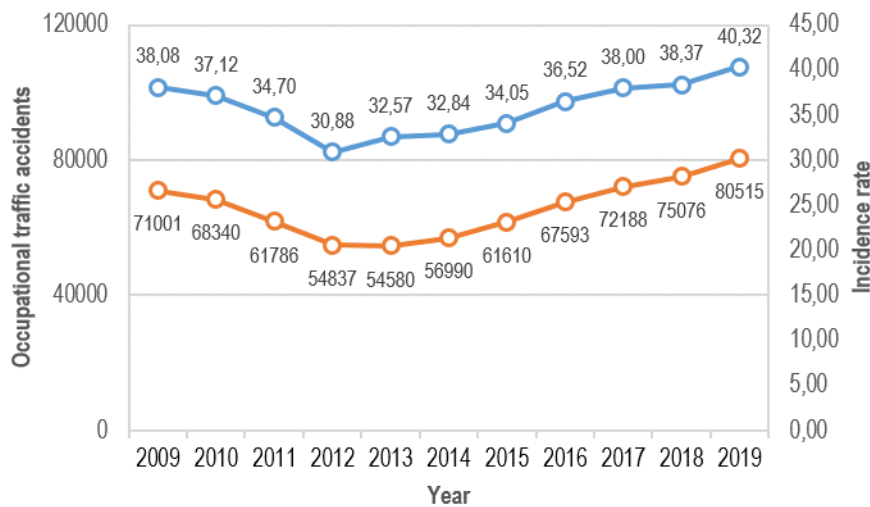


Figure 1. Total number of traffic crashes and incidence rates from 2009 to 2019

TABLE

Severity code	Medical criteria about the consequences of the injuries
Light	No expected long term physical damages for worker.
Serious	No risk for worker life, and no disabling. Expected more than 120 days of absence at work.
Very serious	Risk for worker life and/or disabling
Fatal	Death

Table 1. Medical criteria for severity of the accidents