# Driver Factors in Bus Accident: A Systematic Review

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## Abstract

This article presents a systematic review of the frequency of appearance of different causes in highway bus accidents, for which publications have been searched in SCOPUS and WOS databases. This systematic review has been carried out according to the element guidelines. preferred reporting method for systematic reviews and meta-analyses (PRISMA). Factors linked to drivers have been considered and grouped into seven major items. The results show that the most frequent factors in the publications are those referring to company management, followed by factors linked to driving errors. In this way, it is possible to find where to prioritize studies to eliminate the causes of bus accidents on highways.

## Keywords
Accident Factors, Bus, Drivers, Systematic Review

## 1. Introduction
According to WHO data, in 2016 there were about 1.35 million deaths from traffic accidents, that is, accidents on public roads and involving at least one vehicle, and it is the leading cause of death among children and young people in between 5 to 29 years (Organization 2018). On the other hand, according to the World Health Organization (WHO, 2013), in recent years, the annual number of deaths from traffic accidents worldwide has remained almost constant, despite the fact that the vehicle fleet has suffered a an approximate increase of 15% in the same period, which indicates that the effort made in many countries to improve road safety is notorious. Although it is true that road safety has improved in many countries, the opposite is true in many developing countries, in which fatalities have increased markedly, as is the case in Bangladesh, where the number of people killed by traffic accidents it increased from 1,483 in 1993 to 4,046 in the year 2000, that is, more than 200% (Barua and Tay 2010) (Barua and Tay 2010),

Considering the situation only in America, we see that the average mortality rate is 16.1 per 100,000 inhabitants, corresponding to 11 per 1,000,000 inhabitants for North America, 20.3 for the countries of the southern cone (Brazil, Uruguay, Chile, Argentina, Paraguay) and 22.1, for the countries of the Andean subregion, where Peru is located (WHO 2013).

Considering now only the buses, it is important to highlight that, with the data provided by the World Health Organization (WHO, 2013), the proportion of bus deaths is 0.9% in the United States and 0.5% in the countries of the cone. southern Latin America, regarding deaths from accidents, growing significantly in the Andean subregion, where a value of 1.6% of fatalities due to traffic accidents involving buses is reached, in relation to the total number of fatalities due to traffic accidents. As can be seen, there is a major safety problem on buses in many developing countries (Barua and Tay 2010).

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In all cases there are many causes involved in the accidents, but perhaps the most difficult to solve are those related to the drivers since the human factor is difficult to control, for this reason the main objective of this work is to review the causes related to the drivers, as well as the solutions proposed in this regard, in the scientific literature.

### 1.1 Objectives

It is proposed to develop a systematic review of the presence of causes of accidents linked to drivers, in the scientific literature as a means of devising proposals for improvement.

## 2. Literature Review

Analyzing the causes of accidents in detail, Kaplan and Prato (2012) state that bus accident risk factors include driver characteristics and driver behavior, infrastructure characteristics, environmental conditions, type of collision and interaction with other road users. They do not consider the age of the bus since no significant relationship was found with the severity of the accident, possibly related to the short age of the bus fleet studied (6.6 years on average). In this sense, Zegeer et al. (1994) identified several factors that contribute to the occurrence of transit bus accidents including time of day, lighting conditions, weather and road conditions, bus model year, age and experience of the driver, geometry of the roads, and type of crash.

One of the most difficult causes to study is the one that has to do with human behavior, so it is important to mention that Stevenson et al. (2010) states that fatal accidents involving heavy vehicles are caused by long distances, driving hours, deadlines to meet, among others, which can contribute to a variety of factors that affect driver behavior, including fatigue, stress and the use of stimulants to stay awake, both in Australia and abroad. Likewise, it considers that there is conclusive evidence of the association of heavy vehicle accidents with risk factors related to the driver (including sleep disorders and drowsiness, and state of health), to the characteristics of the road and the vehicle, and to the characteristics employer/company (including scheduling, length of shift, and pay).

According to Chu (2014a), the main causes leading to 1.5-double-decker bus accidents on motorways linked to drivers are: Driving without keeping a safe distance behind the vehicle in front (60% ), improper passing or changing lanes (20%), and reckless driving (20%). This is supported by Nik Mahdi et al. (2014), who affirm that human behavior is the main cause of traffic accidents worldwide, including Malaysia, since optimal sensory and cognitive abilities are required for attention, reception and evaluation of stimuli. incoming while driving. Deficits in any of these skills, as a result of distraction, cognitive impairment, or both, can lead to driving errors.

Duke et al. (2010) indicate that professional heavy vehicle driver fatigue has been identified as one of the main contributors to accidents, since it affects driving performance by altering information processing, attention, and sometimes behaviors. reaction times; it can also cause the driver to fall asleep. Time of day, length of wakefulness, insufficient sleep, disturbed sleep, and long work hours have all been identified as major causes of fatigue. Coincidentally, Chu (2014a) also states that fatigued driving significantly increases the probability of serious injury accidents. This can be explained by the fact that long-distance driving is more likely to cause driver fatigue which reduces alertness and concentration, as well as driver driving ability. In this sense, Nik Mahdi et al. (2014), indicate that sleep disturbance and driver fatigue or drowsiness are important risk factors for traffic accidents according to many studies in the literature, so drowsy drivers have been recognized as constituting a potential safety hazard in passenger transport.

For McCartt et al. (2000), drowsiness is an important factor for accidents, although there is generally little physical or other evidence that a driver crashed due to sleepiness or falling asleep, which is consistent with what was stated by Chu (2014b), who indicates that accidents that occurred at night significantly increased the probability of serious injuries; however, accidents at night, before midnight, cause less serious injuries than those that occur between midnight and dawn, which can be associated with the appearance of great drowsiness. On this same point, Nik Mahdi et al. (2014) indicate that night driving is an additional risk factor, especially during the early morning hours, associated with fatigue and poor visibility.

According to Nordbakke and Sagberg (2007), drivers generally have a good understanding of the various factors that influence the risk of falling asleep at the wheel. Furthermore, most of them are well aware of the most effective measures to prevent falling asleep at the wheel, such as stopping the car and taking a nap. Despite all their knowledge,

most drivers decide to continue driving when they recognize drowsiness while driving. They also state that drivers believe that falling asleep is largely due to little sleep for several days before the accident, long periods of sleeplessness, and the use of medications. On the other hand, according to the same authors, it has been verified that most drivers experience various symptoms of drowsiness before falling asleep while driving, but it seems that some drivers may overestimate their ability to combat drowsiness symptoms.

Dorn et al. (2010), mentions that it has been well documented that bus driving can be a highly stressful occupation and that factors intrinsic to the job, such as time pressure, long work hours and responsibility for safety of the passenger can contribute to the stress of the bus driver. It can also be assumed that bus driver stress and fatigue may lead to increased risk of being involved in a traffic accident, impairing performance, or distracting the driver from maintaining safety on the trip.

On the other hand, for Chang and Yeh (2005), the safety performance of bus companies is determined by many factors, including driver characteristics being a factor to consider, the average number of traffic violations, driver traffic. Chu (2014a) states that driving behaviors, driver characteristics, speeding, drunk driving, fatigued driving and reckless driving significantly increase the probability of serious injury accidents.
Finally Hitosugi et al. (2012), including an important additional cause, indicates that according to a recent report in Finland, driver incapacity caused by sudden illness was the immediate cause of accidents in 10.3% of all fatal cases

## 3. Methods

This section describes the systematic review as a methodological approach to explore useful findings in the existing literature on the causes of driver-related crashes, and to identify where to focus future research. A systematic review is used to identify, select, and assess all literature of a certain agreed level of quality that is relevant to a research question (Booth et al. 2012). This systematic review is performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al. 2009).The sources of the databases used were ISI Web of Science (WoS) and Scopus. The period studied goes from 1995 to 2020 and the search was carried out using the " Title / Abstract / Keyword 'field of the databases. The search began with the words, transportation safety bus drivers, which resulted in 356 documents in SCOPUS and 233 in WOS, modifying the search, the words crash safety bus drivers were used, which reduced to 175 documents in SCOPUS and 177 in WOS.

The first article is from 1985, but there are very few from the 90s, so that until the year 2000 there were only 10 publications on the matter. A total of 352 documents were identified in the two databases, and after eliminating duplicates, this number was reduced to a total of 211 documents.

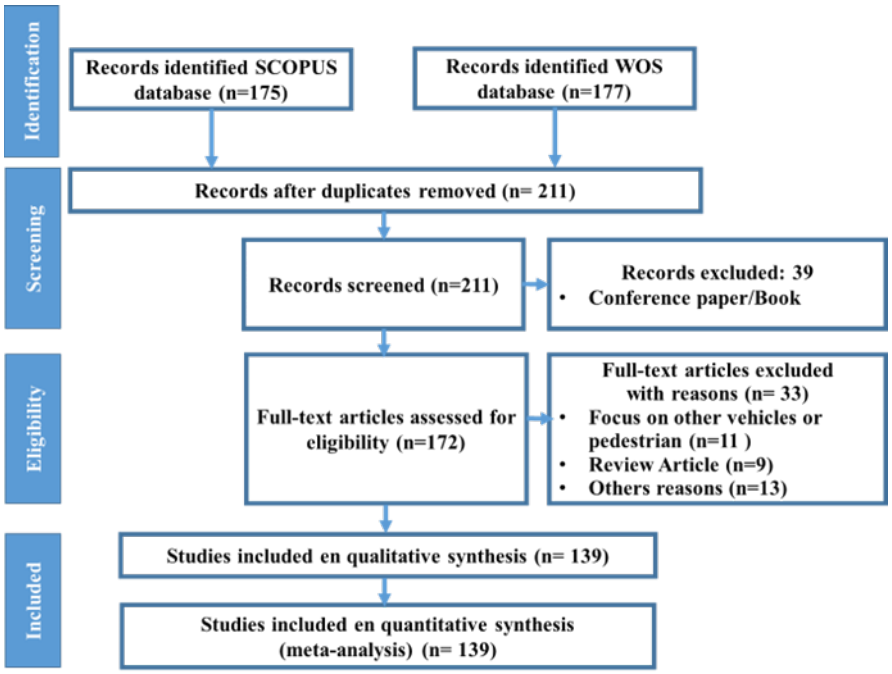


Figure 1. Flowchart of systematic review process. (PRISMA flow diagram).

Of the total number of documents (n = 211), there were 39 articles from congresses and book chapters, the rest were articles, that is, 172. After reviewing all the information, the articles that did not have a DOI or were found to be published, the articles focused on other vehicles such as motorcycles, bicycles or pedestrians, the paper reviews, so that finally there were 139 articles that were reviewed. Figure 1 illustrates the PRISMA flowchart in which the number of documents is shown at each stage after applying the selection criteria. Finally, as can be seen in the figure, 139 documents are reviewed. Add methods here.
A first analysis of the publications studied allows us to find (1) year of publication; (2) title of the journal; (3) country of study. Based on the background, being the relevant part of the review, the causes of the accidents are grouped into (1) Errors or negligence (2) Training (3) Drug use (4) History of penalties (5) Administration (6) State of health (7) Fatigue and drowsiness

## 4. Results and Discussion

Based on the review of the literature and taking into account the aspects raised in point 3, the results obtained are presented in two moments. Section 4.1 presents the results of steps 1 to 3, which allow us to establish the publication framework for the texts that are analyzed. In Section 4.2, the results of steps (1) to (4) related to the objective of the study are presented, which is to determine the causes of accidents related to the driver, in the indicated groups.

### 4.1 Post Famework

Figure 2 shows the annual distribution of articles that deal with the subject of accidents and the evaluation of causes, which were selected for the study. At first glance, it is clear that the number of articles related to this topic has increased in recent years, specifically in the last three years. As of the date of the study, September 2020, this year's publications are partial, but apparently the trend continues to grow.

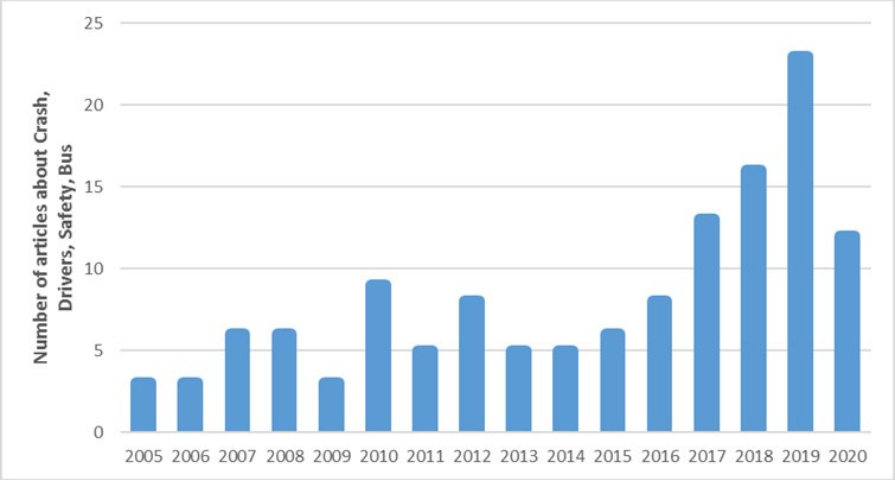


Figure 2. Annual distribution of articles that deal with the subject of accidents and the evaluation of causes

Table 1 shows the number of publications according to the different countries / territories of each article. It is necessary to indicate again that many of the 2020 publications have not been included since they were about to be published and the article was worked on in September 2020.

Table 2 shows journals where a minimum of three articles on crash, safety, bus and drivers have been published, including JCR® Impact Factor and SJR Impact Factor.

Table 1. The number of publications regarding crash safety bus and drivers published by country/region

| **Country/Territory** | **Articles** | **Country/Territory** | **Articles** |
|---|---|---|---|
| United States | 40 | Vietnam | 2 |
| Sweden | 14 | Canada | 2 |
| China | 12 | Belgium | 2 |
| United Kingdom | 8 | Poland | 1 |
| Taiwan | 8 | Thailand | 1 |
| Iran | 6 | Norway | 1 |
| South Korea | 5 | Mexico | 1 |
| Australia | 5 | Austria | 1 |
| India | 4 | Czech Republic | 1 |
| Malaysia | 4 | Pakistan | 1 |
| Italy | 4 | Nigeria | 1 |
| Ghana | 4 | Greece | 1 |
| Spain | 3 | Denmark | 1 |
| Serbia | 3 | Japan | 1 |
| Colombia | 2 | | |

Table 2. Number of documents regarding crash, safety, bus, drivers by source and Impact Factor (only includes journals where three articles or more are published).

| Source | Articles | JCR® Impact Factor 2019 | SJR Impact Factor 2019 |
|---|---|---|---|
| Accident Analysis and Prevention | 31 | 3.655 | 1.69 |
| Transportation Research Record | 16 | 1.029 | 0.54 |
| Traffic Injury Prevention | 10 | 1.678 | 0.839 |
| Journal of Safety Research | 8 | 2.861 | 1.038 |
| Transportation Research Part F: Traffic Psychology and Behaviour | 8 | 2.518 | 1.146 |
| Safety Science | 7 | 4.105 | 1.24 |
| Human Factors: The Journal of Human Factors and Ergonomics Society | 3 | 3.165 | 1.345 |
| IATSS Research | 3 | 2.143 | 0.915 |
| Journal of Advanced Transportation | 3 | 1.67 | 0.569 |
| Journal of Transportation Safety and Security | 3 | 1.642 | 0.533 |

## 4.2 Benchmark Review Highlights

As previously mentioned, this section details the results linked to groupings (1) to (7) that correspond to the causes of accidents linked to the driver. To achieve this, the articles are arranged in a table made up of eight columns, as can be seen in Table 3, which presents a very short extract of what was found. The first presents each article by author and the next seven present the key areas established for this study: Mistakes (MI) Drugs (D) Penalties and Fines (PF) Management (MA) Health Condition (HC) Fatigue and Drowsiness (FD) External Agents (EA) Figure 3 shows a summary of the results in Table 3. The percentages of articles that addressed the seven defined groupings are shown.

Table 3. Key areas Comparative Review

| Source | MI | D | PF | MA | HC | FD | EA |
|---|---|---|---|---|---|---|---|
| Ackaah et al. (Ackaah et al., 2020) | Yes | | | | Yes | | Yes |
| Af Wåhlberg (af Wåhlberg, 2006) | Yes | | | | | | |
| Af Wåhlberg (A. E. Af Wåhlberg, 2006) | Yes | | | | | | |
| Af Wåhlberg (af Wåhlberg, 2007a) | Yes | | Yes | Yes | | | |
| Af Wåhlberg (af Wåhlberg, 2007b) | Yes | | | | | | |
| Af Wåhlberg (af Wåhlberg, 2008b) | Yes | | | Yes | | | |
| Af Wåhlberg (af Wåhlberg, 2008a) | Yes | | | | | | Yes |
| af Wåhlberg (A. Af Wåhlberg, 2018) | Yes | | | Yes | | | |
| Af Wåhlberg and Dorn (af Wåhlberg and Dorn, 2009) | | | Yes | Yes | | | |
| Af Wåhlberg and Dorn (AF Wåhlberg and Dorn, 2019) | | | Yes | Yes | | | |
| Af Wåhlberg and Dorn (af Wåhlberg and Dorn, 2019) | | | | Yes | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Af Wåhlberg and Dorn (Wåhlberg and Dorn, 2019) | | | | Yes | | | |
| Anarkooli et al. (Anarkooli et al., 2017) | Yes | Yes | | Yes | | | Yes |
| Anund et al. (Anund et al., 2010) | Yes | | | | | | |
| Anund et al. (Anund et al., 2016) | | | | Yes | Yes | Yes | |
| Anund et al. (Anund et al., 2018) | | | | Yes | | | |
| Asaoka et al. (Asaoka et al., 2012) | | | | Yes | Yes | Yes | |
| Barua and Tay (Barua and Tay, 2010) | | | | | | | Yes |
| Yusoff et al. (Mohd Yusoff et al., 2010) | | | | Yes | Yes | Yes | |
| Zhang and Chan (T. Zhang and Chan, 2014) | Yes | Yes | | Yes | | Yes | |
| Zhang et al. (Z. Zhang et al., 2019) | | | Yes | Yes | | | |
| Zheng et al. (Zheng et al., 2019) | Yes | | | Yes | Yes | Yes | |

According to the information collected, the causes that appear most frequently in scientific publications are those referring to the management of transport units. Among the causes related to management are: driver experience (personnel selection), driving working hours (considering shift rotation), total number of trips per year, number of drivers for a service route , the continuous hours of driving and the pressure for working conditions.
The second group of causes that are mentioned the most in the publications are those referring to driver errors and that implies a lot of speed, bad driving style, use of distracting objects for the driver such as cell phones, sudden accelerations and misuse of rearview mirrors.

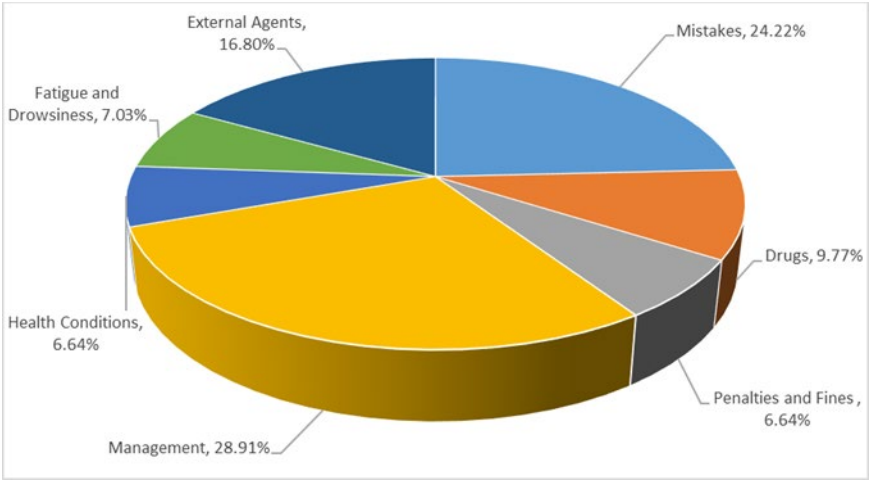


Figure 3. Causes that appear most frequently in scientific publications

In third order of importance are external factors such as characteristics of the accident site (signage, road condition), urban design objects (trees) on the edge of the road, duration of the color (yellow) of the traffic light, weather conditions , lighting conditions, characteristics of the transport route and traffic

## 6. Conclusion

The most frequent factors in the publications are those referring to the management of the companies, followed by factors linked to driving errors and thirdly the external elements that affect the driver.
It is therefore important to take into account causes such as hiring drivers, work schedules, pressure to comply with schedules, frequency of driving, among others.
In the same way, a more exhaustive follow-up of driving errors must be carried out, which surely happens with improving the training of drivers.

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