

Is there a pattern in European bus and coach incidents? A literature analysis with special focus on injury causation and injury mechanisms

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Abstract

In order to identify and describe a pattern in bus and coach incident related injuries and fatalities, and to suggest possible future measures for improvement of bus and coach safety, a literature analysis was performed. The results formed a multi-faceted pattern, which briefly can be described as follows; women travelled more frequently by bus as compared to men. Injuries sustained predominantly affected women 60 years of age and older. Of all traffic fatalities in Europe, bus and coach fatalities represented 0.3–0.5%. In the OECD countries, the risk of being killed or seriously injured was found to be seven to nine times lower for bus and coach occupants as compared to those of car occupants. Despite the fact that fatalities were more frequent on rural roads, a vast majority of all bus and coach casualties occurred on urban roads and in dry weather conditions. Boarding and alighting caused about one-third of all injury cases. Collisions were a major injury-contributing factor. Buses and coaches most frequently collided with cars, but unprotected road users were hit in about one-third of all cases of a collision, the point of impact on the bus or the coach being typically frontal or side. Rollovers occurred in almost all cases of severe coach crashes. In this type of crash projection, total ejection, partial ejection, intrusion and smoke inhalation were the main injury mechanisms and among those, ejection being the most dangerous. A 2-point belt may prevent passenger ejection, but in frontal crashes when the upper abdominal parts and the head hit the seatback in front, it could, however, contribute to head and thoracic injuries. Hence, a 3-point belt provides the best restraint in rollovers and frontal crashes.

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1. Introduction

The traffic in general continues to increase in Europe (European Commission, 2001). Unlike the trend for cars, however, deaths and injuries involving buses and coaches have been stable over recent years in the European Union (EU) (European Commission, 2002). For example, in the eight countries¹ covered by the Enhanced Coach and Bus Occupant Safety (ECBOS)—project approximately 20 000 buses and coaches with a kerb weight >5000 kg, were involved in crashes, the consequences being approximately

35 000 people injured and 150 killed, annually (ECBOS, 2001). In fact, in France, the Netherlands, Spain and Sweden the casualties in buses and coaches have increased during the years 1994–1998 (ECBOS, 2001).

Based on a literature analysis of bus and coach transport, with respect to travel habits, crashes, injury data and restraint systems, possible future preventive measures could hopefully be suggested, in order to contribute to improved safety in buses and coaches. The measures to reduce harm can either be to decrease the probability of a crash (active safety) or minimize the consequences, (passive safety), and in case of an injury-related incident, enhancement of rescue and medical treatment (Evans, 2002).

In the EU, a new bus-directive Directive, 2001/85/EC of the European Parliament and of the Council, (Directive, 2001/85/EC, 2002) has recently been implemented, which

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¹ Austria, France, Germany, Great Britain, Italy, the Netherlands, Spain and Sweden.

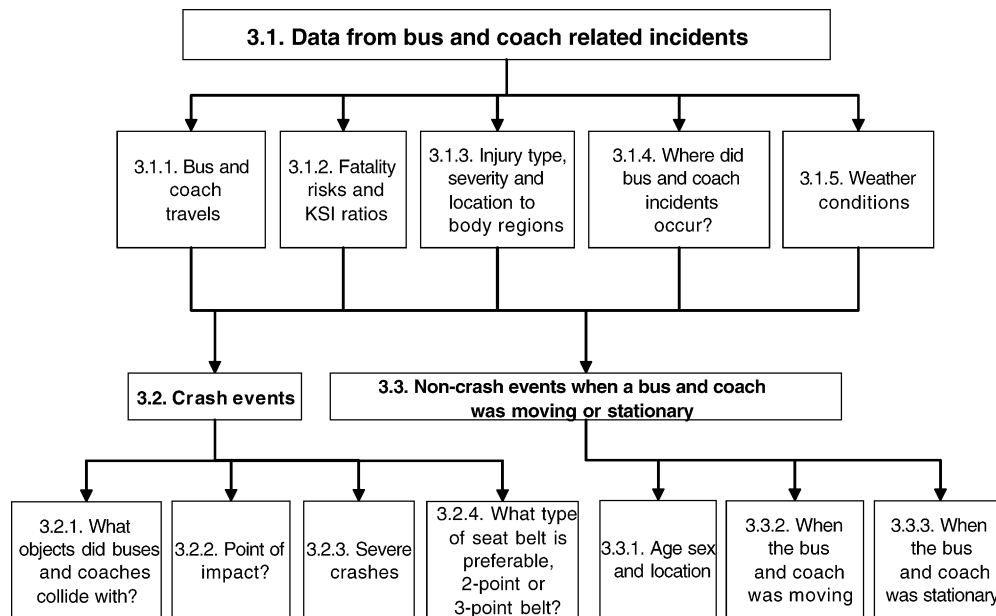


Fig. 1. Analysis structure of all incident events with subheadings.

prescribes mandatory seatbelts² in all new buses or coaches for seated passengers, exclusively. In the present literature analysis, special attention is thus paid to the seatbelt issue, i.e., the passive safety aspect.

1.1. Aim of the study

The aim of the present literature analysis was to identify and describe a pattern in bus- and coach-related incidents leading to injuries and fatalities in Europe, with special attention to injury causation and injury mechanisms, and to suggest some possible future measures for the improvement of bus and coach safety, especially with respect to passive safety.

2. Methods

2.1. Categorization of the included references

Different types of buses and bus crashes are presented in international literature in virtually as many ways as there are articles on the topic. No standard procedure is to be found, which make the analysis complicated. This led the authors to conduct several steps in categorizing the information. One step was to use the term bus or coach “incident”, in order to cover all types of injury events related to bus and coach traffic. Other steps were to utilize bus classifications and injury severity scales. Incidents were, furthermore, divided into crash and non-crash events. The incident structure is shown in Fig. 1 and is used throughout the paper.

The title term ‘incident’ is used because previous researches (Simpson, 1997; Wretstrand, 1999; Falkmer et al., 2001; Falkmer and Gregersen, 2001; Kirk et al., 2001) have indicated that injuries occur even though the bus or coach did not crash, that is a non-crash event. However, in this analysis the authors’ original term is used when quoted, for example accident, crash, collision, incident, and so on, due to the fact that we otherwise may endanger the conclusions drawn.

2.2. Bus classifications

There is no universal definition of buses and coaches. Generally, buses are defined and named after purpose and use. In Europe, the term bus is used to describe a city bus used for short-term transportation of people on urban streets, carrying standing and seated passengers. Local buses and transit buses are other examples of this category. Inter-city bus describes another type that mainly has seated passengers, but is allowed to transport standing passengers and is used on both urban and rural roads. Coach is yet another type, which generally means vehicles transporting seated passengers long distances on rural roads. They are also called tourist/touring coaches or long-distance coaches.

Within the EU, the M-definition was constructed and used, in order to include all road vehicles under a common classification (Directive, 1970/156/EEC, 1970), classifying vehicles after seating capacity, usage and weight. M1 are vehicles with no more than eight passenger seats. M2 are vehicles with more than eight passenger seats and a mass not exceeding 5 tonnes, while M3 are M2 vehicles but exceeding 5 tonnes. The M-definitions are further divided into classes (I–III) depending on field of application.

The concept bus translated into the M-classification means M2 or M3 vehicles class I, with areas for standing passengers

² 2-point belt at minimum.

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