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Characteristics of Single Vehicle Accidents in Europe

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Abstract

About 102.000 people were killed in single vehicle accidents in the 28 European Union countries between 2006 and 2015, representing almost one third of all road accident fatalities in these countries. Single vehicle collision is a type of road accident in which only one vehicle and no other road user is involved. The objective of this research is the analysis of characteristics of single vehicle accidents in European countries through the use of the EU CARE database with disaggregate data on road accidents, as well as of other European data sources (e.g. Eurostat). Time-series data from the EU countries over a period of 10 years (2006-2015) were correlated with basic safety parameters, such as mode of transport, type of road, presence of junction, lighting and weather conditions, seasonality and person related characteristics like age and gender. The results of the analysis allow for an overall assessment of the safety level concerning single vehicle accidents in Europe in comparison to other types of accidents, thus providing useful support to decision makers working for the improvement of safety in the European road network.

Keywords: single vehicle accidents; EU CARE database; road safety; accident causation

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1. Introduction

Road accidents are one of the leading causes of death worldwide, especially among young people aged between 15 and 29 years old. Road traffic injuries claim more than 1,2 million lives each year having a huge impact on public health and development (WHO, 2015). The European Commission has committed to improve the safety of the European road network. On that purpose, the EC has adopted a Road Safety Programme which aims to halve the number of road deaths by 2020, compared to the 2010 level. This target followed an earlier target set in 2001 to cut road fatalities by 50% compared to 2001, which was almost achieved (ETSC, 2017a).

About 102.000 people were killed in single vehicle accidents (SVAs) in the European Union between 2006 and 2015, representing almost one third of all road accident fatalities in these countries. Single vehicle collision is a type of road accident in which only one vehicle and no other road user is involved. Run-off-road collisions, collisions with fallen rocks or debris in the road, rollover crashes within the roadway and collisions with animals are included in this category (EC DG-Move, 2015). While single-vehicle accidents are a unique type of accidents, up to now, they have not been investigated extensively in Europe. However, from the published literature, it can be seen that single vehicle accidents make up a significant proportion of the seriously and fatally injured on European roads (Naing et al., 2007).

Investigation results from several countries indicate that one or more of the factors that are often involved in single vehicle accidents are: speeding or driving too fast for the conditions; drink or drug driving; fatigue; distraction; young and inexperienced drivers; unforgiving roadsides; infrastructure characteristics (geometry, visibility); environmental conditions (rain, ice, snow, fog); technical failure of the vehicle; non-use of seat-belts (ETSC, 2017b). An in-depth study concerning run-off road vehicle accidents on rural roads in two Dutch provinces found that distraction was the most frequent contributory factor related to human behaviour, involved in 31% of the single vehicle accidents studied, followed by speeding (27%), alcohol use (19%) and fatigue (17%). Young drivers appear to be involved in single vehicle accidents when distracted, choosing inadequate swerving manoeuvres to avoid another road user/object or when they incorrectly assess the traffic situation (Davidse et al., 2011).

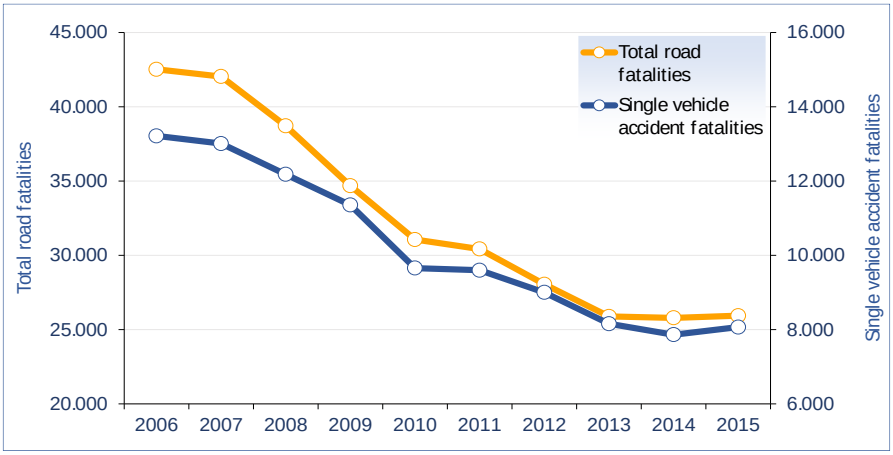
The objective of this research is the analysis of characteristics of single vehicle accidents in European countries, by the use of the EU CARE database with disaggregate data on road accidents, as well as of other European data sources (e.g. Eurostat). More specifically, time-series data on single vehicle accidents from the CARE database for the 28 EU countries over a period of 10 years (2006-2015) are correlated with basic safety parameters, such as mode of transport, type of road, presence of junction, lighting and weather conditions, seasonality and person related characteristics like age and gender. The data, on which this analysis is based, along with much of the analysis and the way that the different types of databases were combined, is obtained through the Traffic Safety Basic Facts 2017 – Single Vehicle Accidents (European Commission, 2017), as well as through SAFETYNET and DaCoTA EC co-funded research projects and the European Road Safety Observatory (ERSO - http://ec.europa.eu/transport/wcm/road_safety/erso/index-2.html).

The results of the analysis allow for an overall assessment of the safety level in Europe concerning single vehicle accidents in comparison to other types of accidents, thus providing useful support to decision makers working for the improvement of safety in the European road network.

2. Overall road safety trends for SVAs in the EU

In 2015, 8.066 persons were killed in single vehicle accidents in the EU countries accounting for 31% of all road fatalities occurred over the same period, with single vehicle accidents constituting a very common type of road accident; for example in the USA SVA fatalities represented 55% of all road accident fatalities in 2015 (FARS, 2016). In order to monitor the evolution of the safety level in Europe concerning the single vehicle accidents, accident trends for the decade 2006 - 2015 were considered. According to the following Figure 1, the number of people killed in single vehicle accidents has decreased by 39%, following a similar trend with that of the total number of road fatalities in the EU, which was reduced by 40% over the same period. However, the annual reduction of the SVA fatalities in 2009 was lower than the respective one of the total number of fatalities (7% and 10% respectively), while in 2010 the most significant annual reduction of SVA fatalities was recorded (15%),

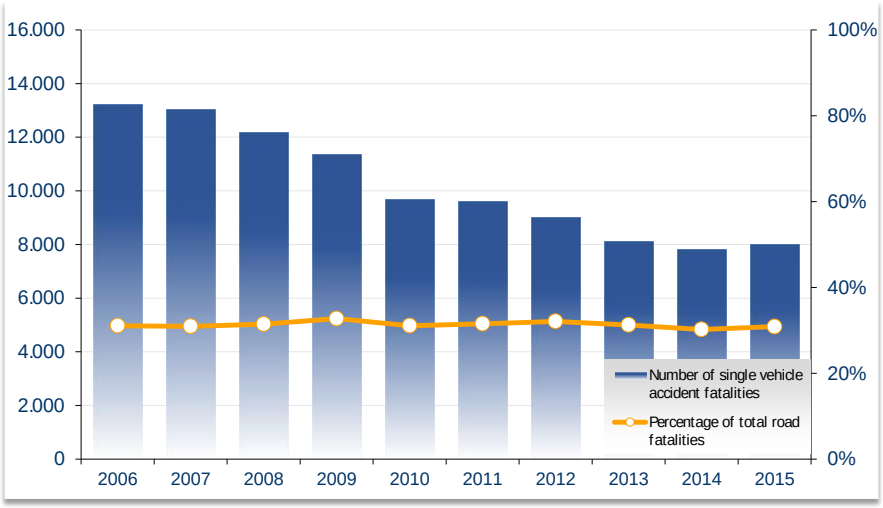
instead of 10% in the total number of fatalities. It is also worth noting that the highest decreases in single vehicle accident fatalities among the EU countries over this decade were recorded in Estonia (63%) and Spain (59%).



Source: CARE database, data available in May 2017

Fig. 1 Number of single vehicle accident fatalities and all road fatalities, EU, 2006-2015

Even though, in 2015, single vehicle accident fatalities constituted on average almost one third of the overall fatalities in the EU, this proportion varied among the EU countries ranging from 22% in the UK up to 39% in France. Figure 2 shows the evolution of the number single vehicle accident fatalities between 2006 and 2015 and the percentage per total road fatalities. While the number of single vehicle accident fatalities in the EU reduced gradually from 2006 to 2015, the percentage of all road fatalities that occurred in single vehicle accidents varied within a narrow range, which is due to the fact that single vehicle accidents follow similar trend with the fatalities of the remaining types of accidents.



Source: CARE database, data available in May 2017

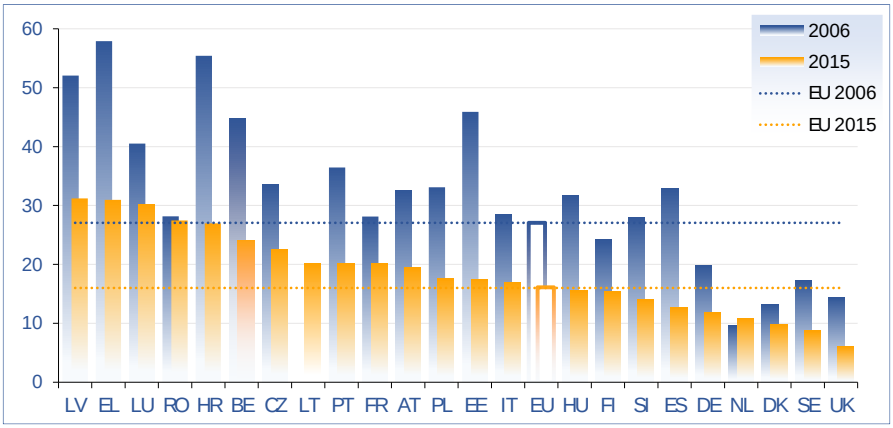
Fig. 2 Number of single vehicle accident fatalities and percentage of all road fatalities, EU, 2006-2015

In road safety analysis exposure data is often used to calculate risk estimates, those being defined as the rate of the number of accidents (or casualties) divided by the amount of exposure of a population over a time period (Hakkert and Braimaster, 2002; Hauer, 1995), on that purpose data from the Eurostat were also used. Since there is no reliable data available about vehicle kilometres or person kilometres travelled in each of the above countries, the population is used as exposure data. The calculated risk figures may be used for different purposes, but their main objective is to enable the comparison of safety performance among different units, populations or countries.

Figure 3 shows the SVA fatality rates per million population in the EU countries in 2006 and 2015. The average EU fatality rate was reduced by 40% over this period, however, this differs among the countries. The highest

reduction in fatalities occurred in single vehicle accidents was recorded in Estonia and Spain (62%), while the Netherlands was the only country in which an increase was recorded. It is also worth noting that Latvia, Greece and Romania had a SVA fatality rate in 2015 that was higher than the EU average for 2006.

Additionally, in 2015 the lowest fatality rates per million population were recorded in the United Kingdom and Sweden, while Latvia and Greece recorded the highest fatality rates, with the Latvian one being about twice the average EU rate.



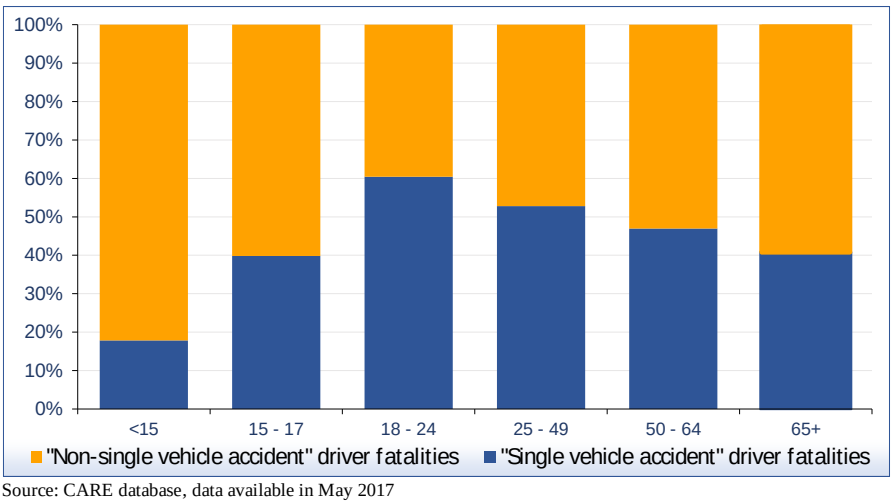
Source: CARE database (EUROSTAT for population data), data available in May 2017

Fig. 3 Single vehicle accident fatality rates per million population, EU, 2006 and 2015 or latest available year

3. Road safety parameters of SVAs in the EU

The results of a more detailed analysis follow with data referring to 2015. It should be noted that for those countries that have no available data for 2015, the latest available data are used, meaning 2009 data for Bulgaria, 2010 data for Malta and Slovakia, 2013 data for Ireland and 2014 data for Sweden.

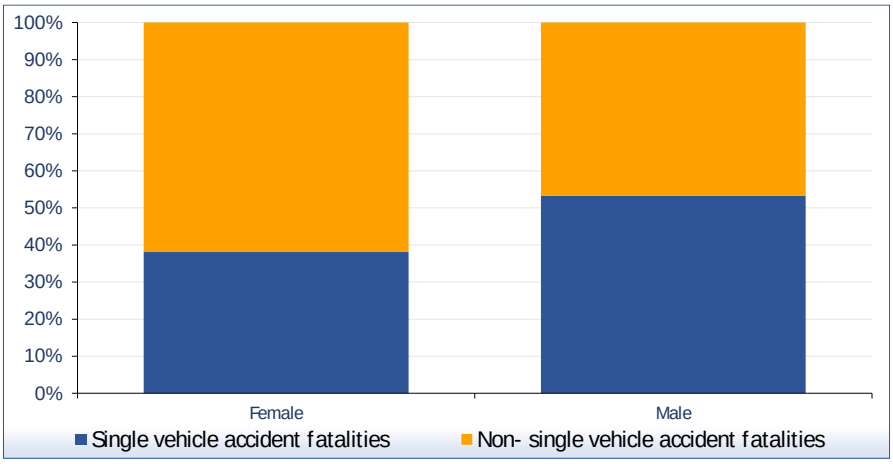
According to the results of the analysis by age group, the percentages of drivers aged 18-49 years old who were killed in single vehicle accidents were higher than the respective percentages of drivers killed in non-single vehicle accidents. More specifically, the highest percentage of drivers killed in road accidents was 44% and concerned those aged between 25-49 years old (40% for those killed in non-single vehicle accidents), while the percentage of drivers aged 18-24 years old was 19% (12% is the respective percentage in non-single vehicle accidents). The following figure shows the distribution of driver fatalities in single and non-single vehicle accidents by age group. Almost 60% of killed drivers aged 18-24 years old were killed in single vehicle road accidents.



Source: CARE database, data available in May 2017

Fig. 4 Distribution of single and non-single vehicle accident fatalities of drivers by age group, EU, 2015 or latest available year

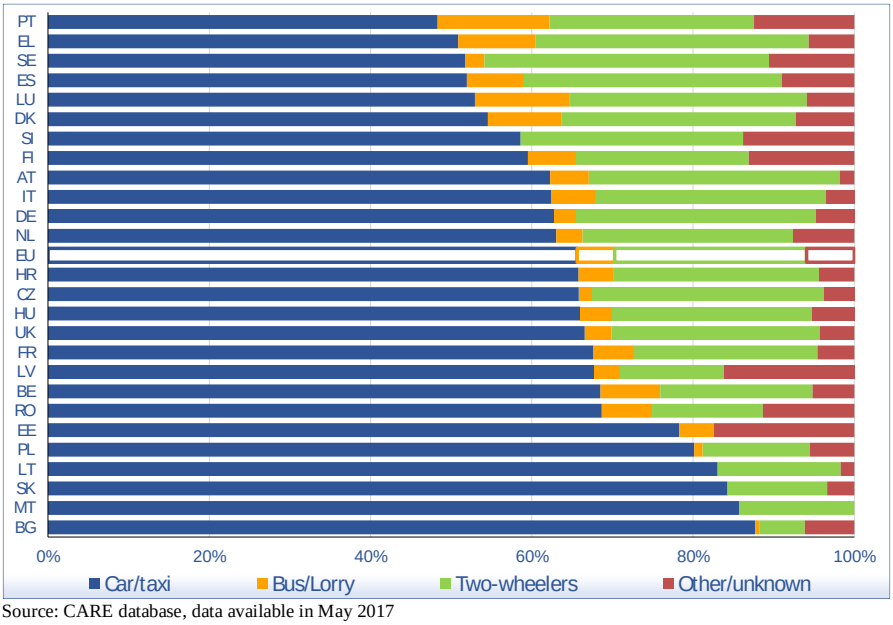
As far as the drivers' gender is concerned, males account for 83% of the single vehicle accident fatalities in the EU countries in 2015. Figure 5 indicates that almost two fifths of all female fatalities occurred in single vehicle accidents, compared with over half of male fatalities.



Source: CARE database, data available in May 2017

Fig. 5 Distribution of single and non-single vehicle accident fatalities by gender, EU, 2015 or latest available year

Transport of mode was also considered in the analysis. It was shown that the percentage of fatalities is highest for car/taxis (66%), while the two-wheeler fatalities (mopeds, motorcycles and pedal cycles) accounted for 24% in 2015. According to the distribution of SVA fatalities by transport mode in each EU country, the percentage of car and taxi fatalities in single vehicle accidents was highest in Lithuania (83%) and lowest in Portugal (48%). As far as two wheelers' fatalities are concerned, the lowest proportion was recorded in Slovakia (12%), Latvia and Poland (13%) as shown in Figure 6. Sweden had the highest proportion of two wheelers' fatalities (35%) among the EU countries. Portugal and Greece had the highest percentages (14% and 10% respectively) of fatalities in lorries and buses among the other countries.

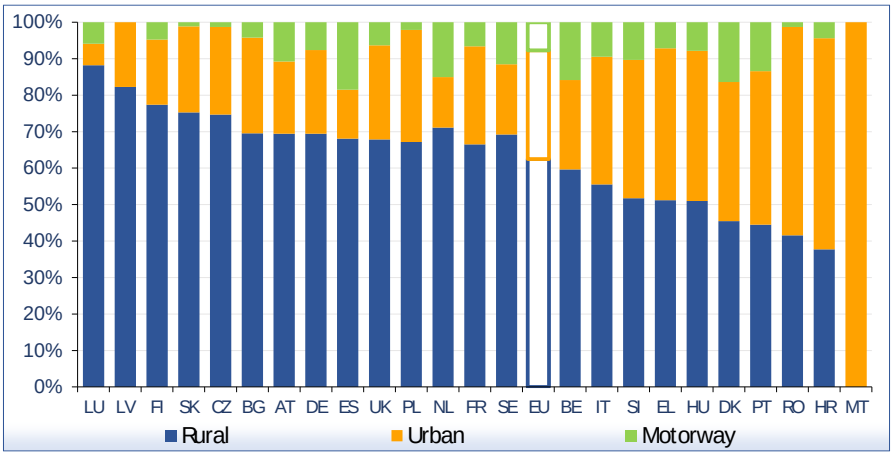


Source: CARE database, data available in May 2017

Fig. 6 Distribution of single vehicle accident fatalities by country and mode of transport, 2015 or latest available year

The distribution of single vehicle accident fatalities in the EU by area and road type were also examined. 62% of the SVA fatalities occurred outside urban areas, more than twice the respective percentage inside urban areas

(29%). However, the situation differs among the EU countries, for instance in Croatia and Romania most SVA fatalities occurred inside urban areas (58% and 57% respectively), followed by Greece and Portugal (42%). On the other hand, Spain was the country with the highest percentage of SVA fatalities occurred on motorways (19%, with the EU average being 8%).



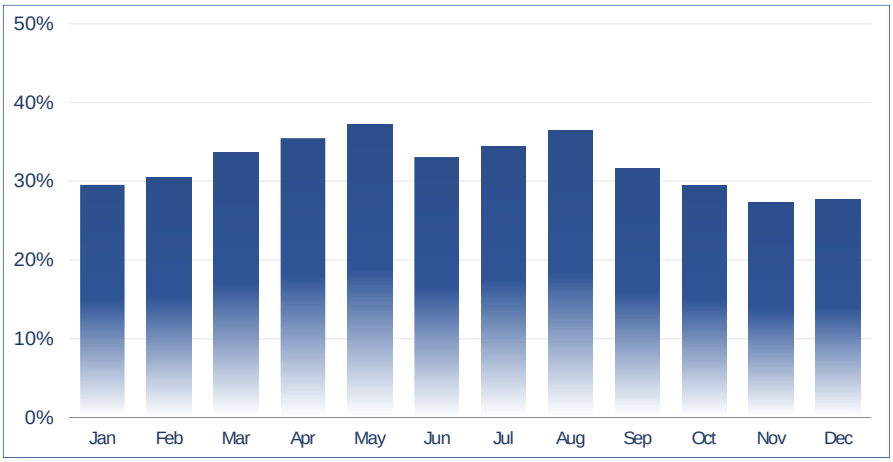
Source: CARE database, data available in May 2017

Fig. 7 Distribution of single vehicle accident fatalities by country and area type, 2015 or latest available year

In addition, the percentages of fatalities that occurred in single vehicle accidents by area and road type in 2015 were also calculated. More specifically, in the EU about a quarter of all road fatalities inside urban areas and a third of all motorway fatalities occurred in single vehicle accidents.

The vehicle manoeuvre type was also considered in relation to the area type. Thus, the distributions of SVA fatalities by manoeuvre type inside and outside urban area were calculated, showing that the vehicle manoeuvre most frequently associated with single vehicle accident fatalities is driving 'straight ahead' for both types of area. It is noted though that more than 70% of the single vehicle accident fatalities occurring in both areas by manoeuvre type are not defined.

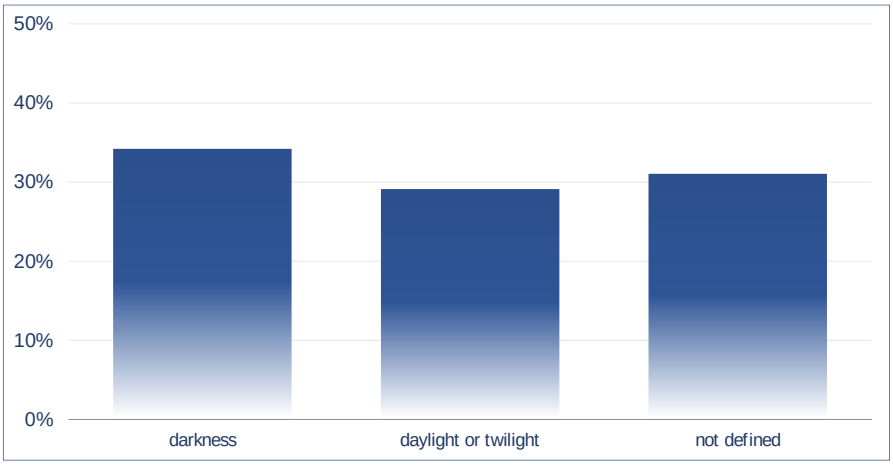
In order to answer the question when most single vehicle accidents occur, the analysis of the fatalities seasonal distribution showed that there is a similar trend in the incidence of SVA fatalities by month to that of the total number of fatalities. In 2015, the peak for the EU countries occurred in July and August (22%) and the fewest fatalities occurred in January and February (13%). Figure 8 displays the fatalities that occurred in single vehicle accidents as a percentage of all road fatalities per month in the EU. 37% of the fatalities in May and 36% in August occurred in single vehicle accidents, while the lowest percentages occurred in November (27%) and December (28%).



Source: CARE database, data available in May 2017

Fig. 8 Percentage of single vehicle accident fatalities of all road fatalities by month, EU, 2015 or latest available year

The role of light conditions on the incidence of single vehicle accident fatalities is also important, since 33% of these fatalities occurred in darkness, whilst 51% occurred in daylight or twilight. The percentage of single vehicle accident fatalities per total road fatalities by lighting conditions is presented in the following figure. In 2015, one third of the fatalities that occurred in darkness concerned single vehicle accidents (34,2%), with the respective percentage in daylight or twilight being below 30%.

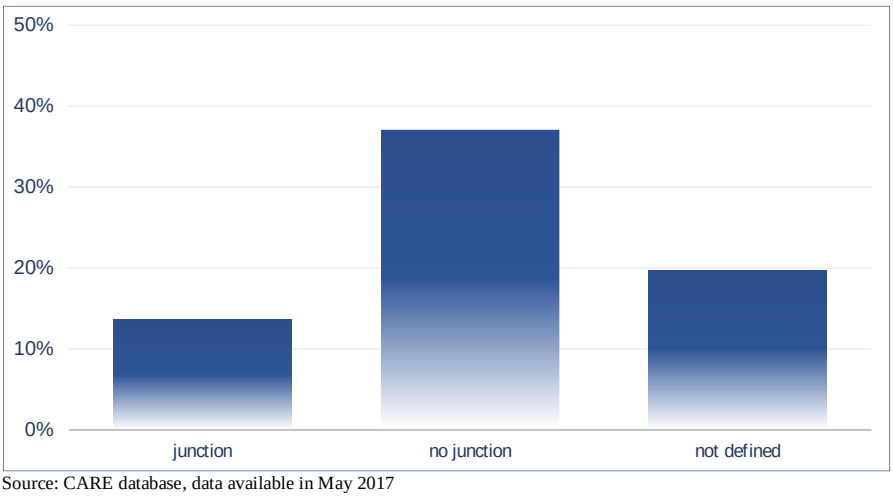


Source: CARE database, data available in May 2017

Fig. 9 Percentage of single vehicle accident fatalities of all road fatalities by lighting conditions, EU, 2015 or latest available year

From the analysis carried out, it was also found that the highest percentage of single vehicle accident fatalities is observed in dry weather (73%), an 8% of SVA fatalities occurred under rainy conditions, while the percentage in snow was least (0,4%). However, 27% of all road fatalities that occurred in snow involved a single vehicle, compared with 31% for rainy weather.

Finally, it was found that the highest number of fatalities was recorded at no junction areas, corresponding to 91% of the single vehicle accident fatalities in the EU countries. Figure 9 presents the percentage of fatalities that occurred in single vehicle accidents at and not at a junction in the EU. 37% of the fatalities that occurred at no junction area involved a single vehicle, compared with 14% at a junction.



Source: CARE database, data available in May 2017

Fig. 10 Percentage of single vehicle accident fatalities of all road fatalities by existence of junction, EU, 2015 or latest available year

4. Conclusions - Discussion

The various road safety parameters examined revealed that the single vehicle accidents have at a significant level different characteristics compared to other types of road accidents, since specific types of road users or vehicles are more commonly involved in such accidents. The safety problem varies also systematically by region, reflecting

different climates, cultures and behavioural characteristics, intensity of traffic, modal shares, level of road infrastructure development and technology readiness levels.

Analysis of the single vehicle accident data derived from the EC CARE database for the decade 2006 – 2015, showed that the number of single vehicle accident fatalities has decreased appreciably by 39% over this period in the EU countries, however the overall number of road accident fatalities had a similar trend and the share of single vehicle accident fatalities of all road fatalities in the EU varied within a narrow range. According to the results of the detailed analysis, more than 60% of drivers killed in single vehicle accidents were aged between 18-49 years old, with the percentage of drivers aged 18-24 years old killed in single vehicle accidents being much higher than the respective percentage in non-single vehicle accidents. Additionally, the percentage of SVA fatalities was highest for car/taxis (66%), while two-wheeler fatalities (mopeds, motorcycles and pedal cycles) accounted for 24% in 2015. In the EU, single vehicle accident fatalities occurring outside urban areas account for more than twice the respective percentage inside urban areas and occur mostly at no junction areas. A high percentage of SVA fatalities (33%) occurred in darkness, as well as in dry weather.

As literature has shown, human error such as driving with inappropriate speed or under the influence of alcohol/drugs or distracted can contribute to a road accident, while driver's age and gender play a significant role, as well. Subsequently, road infrastructure characteristics and roadside design are even more important factors. On that purpose, cost-effective measures have to be taken including both more efficient traffic law enforcement, and improvements in the whole road network applying the concepts of "self-explaining roads" and "forgiving roadsides" (ETSC, 2017b).

The results of the analysis allow for an overall assessment of the safety level in the European road network concerning single vehicle accidents in comparison to other types of accidents, providing thus useful support to decision makers working for the improvement of safety in the European road network. Certainly, the effort of data-collection is an on-going challenge and there are additional data that could help shed light to the road safety problem. Of particular interest are exposure data related to the mobility of road users (veh-kms, passenger-kms travelled) in total as well as by gender and age group of road users and transport mode. Furthermore, the macroscopic analysis presented in this paper could in the future be combined with more detailed analysis using statistical models, which is necessary for the identification of the combined correlation of the parameters with an impact on single vehicle accidents and the underlining reasons behind the related casualties.

Acknowledgements

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National Highway Traffic Safety Administration (NHTSA) data resource website

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Appendix A - Country abbreviations

Belgium	BE
Bulgaria	BG
Czech Republic	CZ
Denmark	DK
Germany	DE
Estonia	EE
Ireland	IE
Greece	EL
Spain	ES
France	FR
Croatia	HR

Italy	IT
Cyprus	CY
Latvia	LV
Lithuania	LT
Luxembourg	LU
Hungary	HU
Malta	MT
Netherlands	NL
Austria	AT
Poland	PL
Portugal	PT

Romania	RO
Slovenia	SI
Slovakia	SK
Finland	FI
Sweden	SE
United Kingdom	UK