PARAMETERS AFFECTING ROAD FATALITIES OUTSIDE URBAN AREAS IN EUROPE

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ABSTRACT

More than 225.000 people were killed in traffic accidents on roads outside urban areas (hereinafter “ROU areas”), in 17 European Union countries between 2000 and 2009, representing 55% of all traffic accident fatalities in those countries. The objective of this research is the analysis of road safety related characteristics of road accidents outside urban areas in European countries through the use of the EU CARE database with disaggregated data on road accidents, as well as of other international data sources (Eurostat, OECD/IRTAD, etc.). Time-series data from 17 EU countries over a period of 10 year (2000-2009) are correlated with basic safety parameters such as mode of transport, presence of junction, lighting and road surface conditions, person class and person characteristics like age and gender. During this period an overall decrease of almost 40% in traffic accident fatalities outside urban areas was observed, with values ranging between a decrease of 64% in Portugal and an increase by 122% in Romania. The results of the analysis allow for an overall assessment of the road safety level in European rural areas also in comparison to the urban areas, providing thus useful support to decision makers working for the improvement of safety in the European road network.

Keywords: Road outside urban areas; Road fatalities; Road accident data; Road safety; European countries

INTRODUCTION

In this research, Roads Outside urban areas are defined as rural roads and do not include motorways. The wide variety of principles and implementation practices used in road classification schemes obscures a correct representation of the size and nature of the road safety problem and makes it difficult to compare safety on roads outside urban areas across countries. In spite of this, it is apparent that as much as 80% of all accidents on roads outside urban areas falls into three categories: single vehicle accidents. especially running off the road, head-on collisions and collisions at intersections (OECD, 1999).

Single vehicle accidents constitute more than 35% of all fatal road accidents outside urban areas. This type of accident is the most prevalent because all three elements of the family of hazard factors – driver behaviour, vehicle, and road (infrastructure) environment -- contribute to these accidents and increase their severity (TRL, 2004). Head-on collisions make up nearly 25% of all fatal accidents on rural roads. Driver behavior and the road environment are the principal factors in these accidents. Collisions at intersections account for about 20% of all fatal rural road accidents. Again, driver behaviour and road infrastructure are the key contributing factors to these types of accidents (OECD, 1999)

Rural road accidents are scattered over the entire rural road network. Under these circumstances, a pressing challenge for safety professionals is to understand their causes and the contributing factors. According to Karlaftis and Golias (2001) a main conclusion is that the rural road system itself has inherent characteristics that significantly contribute to the high number of accidents and the high risks.

Inappropriate and excessive speeds are a key factor in rural road accidents because the actual speeds on rural roads are relatively high under circumstances where these high speeds cannot be safely maintained. Rural roads generally have inconsistent design characteristics over their entire length, as well as problems in individual design elements. This requires constant speed adaptation to account for regularly changing situations and circumstances, thus increasing the opportunities for human errors and leading to higher risks for accidents. Consequently, reducing inappropriate and excessive speed together with safe road and roadside design are the key elements to improve rural road safety. Aside from this, fatigue and alcohol/drug use are also key factors in rural safety. Equally importantly, speed variation caused by the presence of buses, heavy trucks, agricultural vehicles, mopeds and bicyclists generates higher accident risks than on other types of roads (OECD, 1999). Speed variation generates more instances of overtaking, which in turn is a dangerous manoeuvre, as evidenced by the fact that head-on collisions are one of the major accident types on rural roads. In addition, it is common to find slow-moving vehicles, such as agricultural vehicles, mopeds and cyclists, on rural roads. When traffic such as this is using the same physical space as fast-moving automobiles, the risk of accident is amplified (OECD, 2002).

The objective of this research is the macroscopic analysis of safety related parameters in ROU areas in the European road networks, using data from the EU CARE database with

disaggregate data on road accidents, together with data from other international data files (e.g. EUROSTAT, as well as national sources). More specifically, accident data on roads outside urban areas for the period 2000-2009 and 17 EU countries (Table I) are correlated with basic safety parameters like the mode of transport, the lighting conditions, age, gender, person class and the type of junction. The data on which this analysis is based, along with much of the analysis, is obtained through the DACOTA project and the European Road Safety Observatory (ERSO).

Table I summarizes the definition of the country abbreviations that are used in the remainder of this paper. It has to be underlined that for all presented statistics (where specific dates are not indicated, latest available data are used i.e. 2009 for all countries except LU (2008) EE (2008) and SE (2008).

Table I – Definition of used country abbreviations

EU-17	
BE	Belgium
CZ	Czech Republic
DK	Denmark
DE	Germany
EL	Greece
ES	Spain
FR	France
IT	Italy
LU	Luxembourg
AT	Austria
PL	Poland
PT	Portugal
RO	Romania
SI	Slovenia
FI	Finland
SE	Sweden
UK	United Kingdom (GB+NI)

EU-22 = EU-17 +	
EE	Estonia
LV	Latvia
HU	Hungary
NL	The Netherlands
SK	Slovakia

This paper presents a wealth of macroscopic data that provides an up-to-date view on the topic of ROU areas safety. The analysis can be used to develop strategies for the decision support of targeting infrastructure improvements so that they will be most effective.

OVERALL TRENDS

The trends of number of fatalities overall and at ROU areas in 17 European Union countries are shown in Figure 1. More than 225.000 people were killed in traffic accidents on ROU areas in 17 European Union countries between 2000 and 2009. This number represents 55%

of all traffic accident fatalities in those countries. Fatalities on ROU areas have reduced by 40% over the last decade (from 27.452 in 2000 to 16.389 in 2009), following a similar trend to the total number of fatalities (that has reduced by 38% during the same period). The greatest decrease on ROU areas was recorded in 2009, with a fall of 10,8% compared to 2008.

An increase of fatalities on roads outside urban areas between 2000 and 2009 is observed only in Romania (122%), whereas the greatest reduction was noted in Portugal (64%) and Luxembourg (57%).

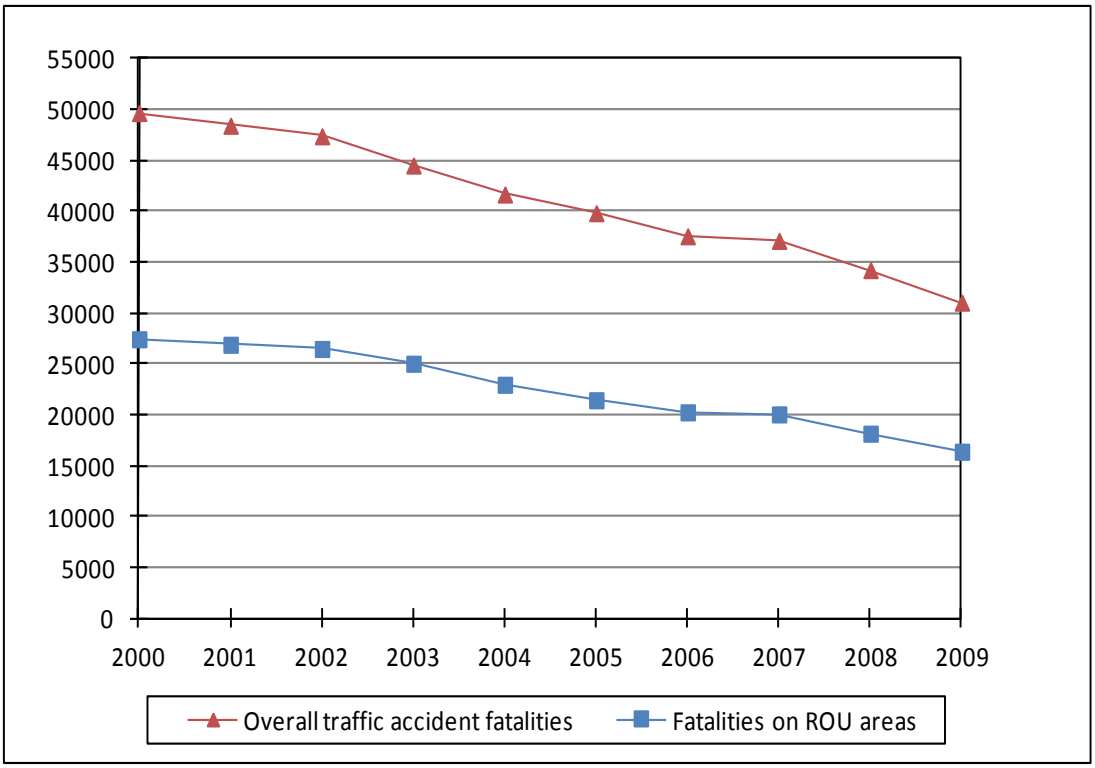

Figure 1 – Fatalities in EU-17, 2000-2009

Furthermore, Figure 2 presents the proportion of road accident fatalities that occurred on ROU areas with the total number of road accident fatalities during the same period (2000-2009).

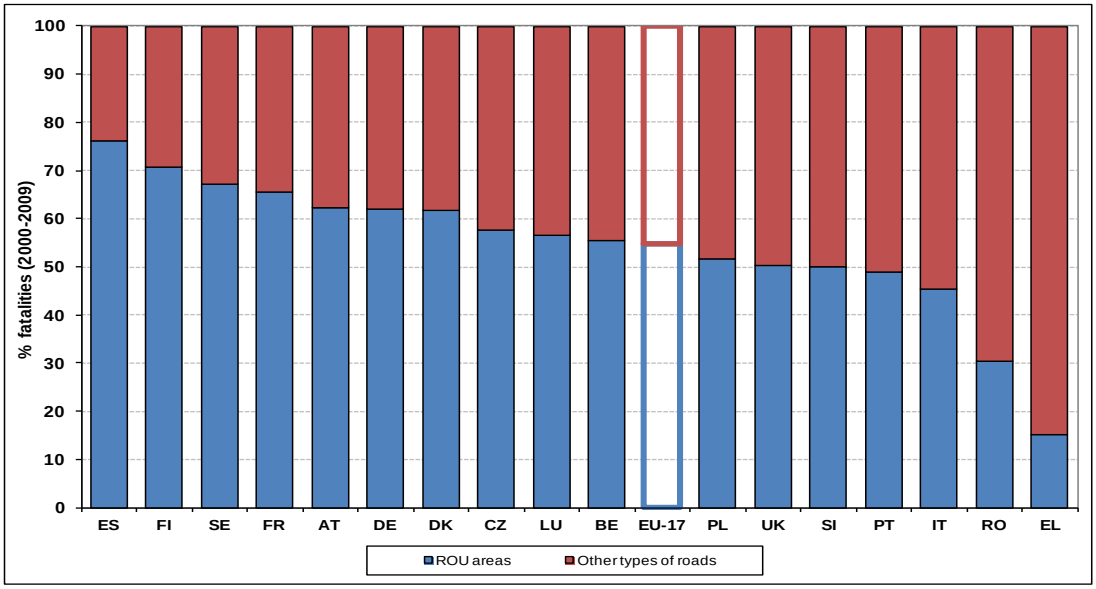

Figure II – on ROU areas as a percentage of total fatalities in EU-17 (2000-2009)

An analysis of the proportion of the overall road fatalities during the same period (2000-2009) that occurred in ROU areas indicates that the highest percentages were obtained in Spain (76%) and Finland (71%), whereas the lowest were recorded in Greece and Romania, where fatalities in ROU areas constitute a minority of the overall road accidents fatalities.

In order to compare the fatality data for ROU areas in the different countries, the respective population size was taken into account. In 2009, more than 80 people per million inhabitants were killed in accidents in roads outside urban areas in Latvia (the highest rate). This rate is more than twice as high as the EU-22 rate (36,6) and more than 4 times higher than the Greek rate (the lowest), as shown in Figure 3. .

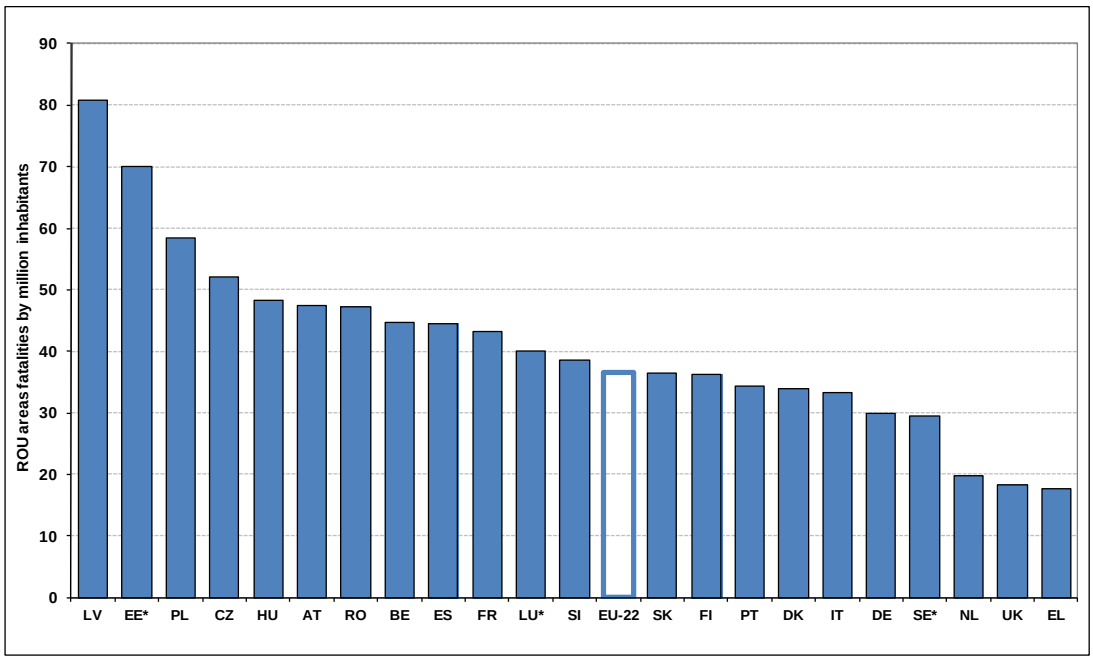

Figure 3 – Fatalities per million inhabitants on ROU areas by country in EU-22, 2009

DISTRIBUTION BY MODE OF TRANSPORT

Figure 4 visualises the distribution of fatalities on roads outside urban areas by mode of transport in the EU-17, for the year 2009.

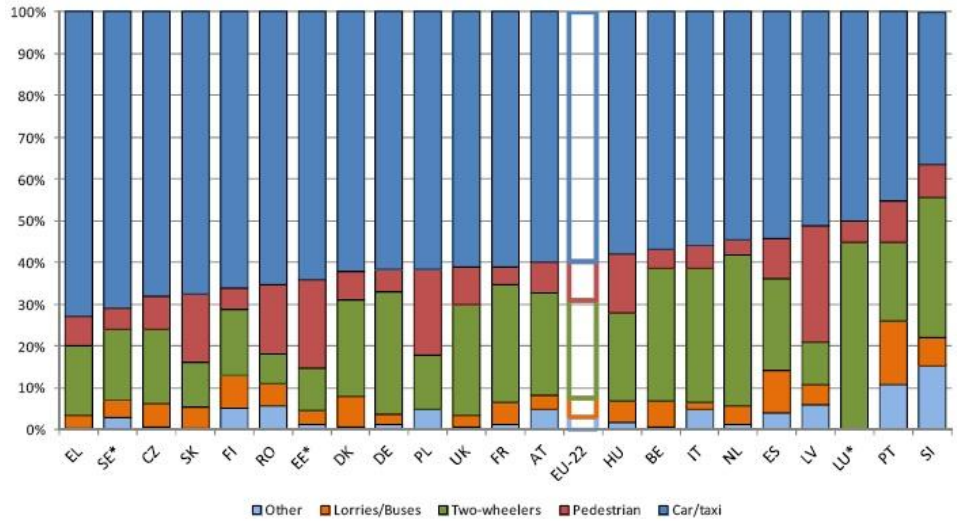

Figure 4 – Distribution of fatalities on ROU areas by mode of transport in the EU-22, 2009

Several observations can be based on these data: Greece has the highest percentage (73%) of fatalities on ROU areas by car or taxi, while Slovenia has the lowest (36%) and the EU-22 average is 60%. The higher speeds on rural roads increase the chance that an accident will be fatal but there is also evidence that many children living in rural areas are less likely to wear a seatbelt for every journey and especially when the journey that they are taking is relatively short. Furthemore, the geometrical characteristics of rural roads (narrow, bendy but allowing high speeds) is a likely cause for the severity of collisions experienced (Hamilton and Kennedy, 2005).

Motorcycle safety on rural roads is a major concern that needs to be tackled, as 23% of EU-22 fatalities on ROU areas in 2009 were riders of two-wheeler vehicles (motorcycle, moped or pedal cycle users), with the percentages being highest in Luxembourg (45%) and Slovenia (34%). The high number of fatalities could be related to the fact that most motorcyclists use rural roads for recreational/weekend driving and might lack sufficient knowledge of the road network. The most common types of motorcyclist accidents are (Department for Transport, 2004):

- Failure to negotiate bends on rural roads
- Collision at junctions
- Collision while overtaking
- Rider losing control without another vehicle being involved

Regarding pedestrians, 28% of the fatalities on ROU areas in Latvia were pedestrians,forming the largest proportion in the EU-22. By design, rural roads are narrow and often have no pavement or crossing facilities. Additionally, child pedestrian casualties in rural areas are more likely to occur when children are walking along the road rather than crossing it.

JUNCTION ON ROU AREAS

Hughes et al (1997) examined several different factors associated with increased accident frequency at dual carriageway junctions. These included the number of vehicles entering and leaving the main road at grade-separated junctions; minor road traffic flow at T-junctions, vertical alignment issues, and issues associated with gaps in the central reserve. The results showed that increasing the distance between junctions, providing a wide verge on the off-side of slip roads, and/or increasing on-slip merge lengths decreased the accident frequency. Another outcome was that older drivers had greater involvement in accidents involving a right turn or crossing the main carriageway at junctions.

In 2009, almost 55% of the fatalities in non-junction accidents that occurred in the EU-20 countries (Given the high number of unknown case at junction Germany and Sweden have not been considered in this analysis) are recorded on ROU areas. However, this percentage is higher in Spain (79.2%), Latvia (77.6%) and Estonia (70.3%). More than one third of the fatalities recorded at junctions occur on ROU areas. This proportion is much higher in Estonia (65.8%) and is also high in Finland (62.7%), Belgium (59.8%) and Spain (56.8%). Greece has the lowest proportion of fatalities on ROU areas both at junctions and not at junctions.

In the following Figure 5 the distribution of fatalities on ROU areas according to the road design (i.e. at junction, not at junction) is presented in the EU-20 countries. While 85% of the total of the ROU areas fatalities did not occur at junctions, this percentage is higher in Latvia (99%), Greece (98%) and Slovenia and Romania (95%). Furthermore, although the EU-20 percentage of fatalities on ROU areas is lower at junctions (14.8%), Italy, Estonia, Denmark and the Netherlands have a higher percentage than the EU average (more than 26%).

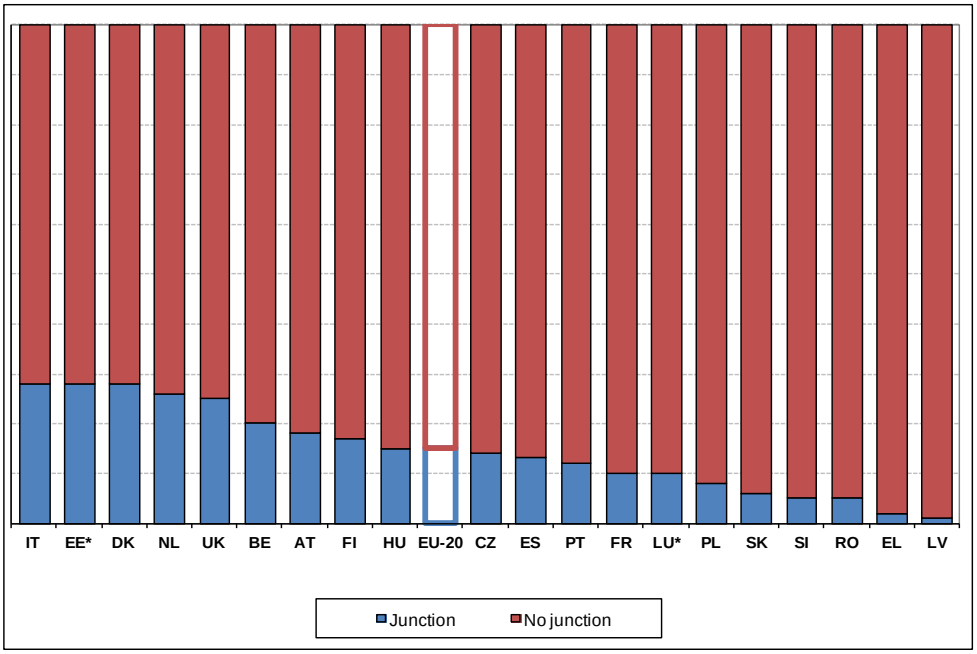

Figure 5 – Fatalities on junction/no junction ROU areas by country in EU-20, 2009

CORELLATION WITH OTHER BY ROAD SAFETY PARAMETERS

Classification by lighting conditions

According to a study into the potential effects of adopting SDST (Broughton and Stone, 1998) the effects of darkness are greater for pedestrians than for vehicle occupants and greater for fatalities than non-fatalities. Overall, Broughton and Stone predicted that KSI casualty rates for the whole of Great Britain for the period 1991-1994 would have been 0.8% lower had SDST been in place. The predicted reduction for Scotland was slightly lower at 0.7%. However, it should be noted that the separate analysis for Scotland was limited by sparse data - particularly in the morning. The data could not be disaggregated by severity, time of day or into pedestrian and vehicle occupants. Therefore, the effect of SDST on rural and motorway casualty rates in Scotland is not clear.

Table II shows that in the 20 EU countries, the proportion of fatalities in daylight conditions is slightly higher on ROU areas (57.9%) than on urban areas or motorways. More specifically, 35.5% of the ROU areas fatalities occurred in accidents in the dark, this percentage being slightly lower than in urban areas (39.7%) and also lower than on motorways (44.6%).

The “darkness” variable is further broken down into specific lighting conditions that can occur with darkness conditions. In ROU areas, about 20% of the fatalities occured when it was dark, without any street light on. However, the proportions of the different categories of

"darkness" may be distorted because of the high percentage of unknown in the variable describing whether the street light is lit or unlit.

Table II – Fatalities on ROU areas, urban areas and motorways by lighting conditions in EU-20, 2009

	ROU areas	Urban areas (no motorways)	Motorways	Total
Daylight	57,9%	53,1%	49,8%	55,8%
Twilight	6,5%	6,9%	5,0%	6,5%
Darkness - no street lights	19,6%	6,8%	15,6%	15,1%
Darkness - street lights lit	5,4%	25,6%	9,7%	12,4%
Darkness - street lights unknown	8,0%	5,3%	15,0%	7,5%
Darkness - street lights unlit	2,5%	2,0%	4,3%	2,4%
Unknown	0,1%	0,2%	0,6%	0,2%
Total	16.731	9.259	1.642	27.631

Classification by age

Figure 6 shows the age distribution of the persons killed in accidents on ROU areas in 2009 in 22 EU countries, also compared to the respective fatalities on urban roads. More than half of the fatalities on ROU areas were aged 25-59 and a lower percentage of elderly people are killed on ROU roads than on roads in urban areas Furthermore, even though they represent low frequencies with respect to the total numer of fatalities, the country with the higher proportion of child fatalities on ROU areas is Greece (4.5%). In the 15-24 age group, the highest proportion is recorded in Luxembourg (high proportion in the 25-39 group as well) and Germany. In contrast, Hungary and Latvia have the highest proportions of adult fatalities on ROU areas, while Finland and Slovenia show a high percentage of fatalities in the 60+ age group.

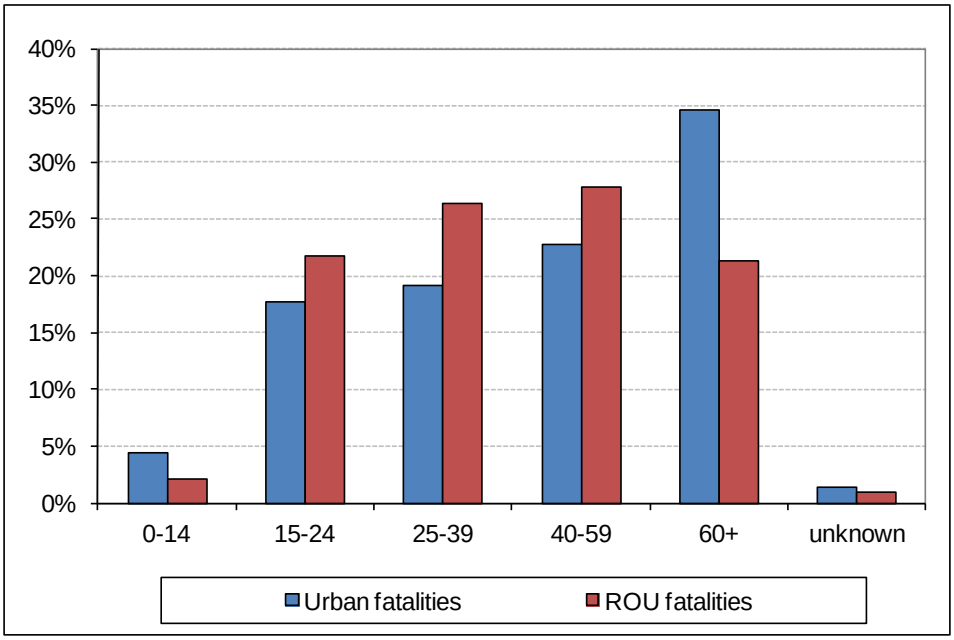

Figure 6 – Distribution of fatalities in accidents on ROU areas and in accidents on roads in urban areas by age group in EU-22, 2009

Classification by gender

Figure 7 shows how fatalities on ROU areas are distributed by gender. Slovenia is the country with the lowest percentage of female fatalities (14%) while Denmark and Sweden are the countries with the lowest percentage of male fatalities (74%).

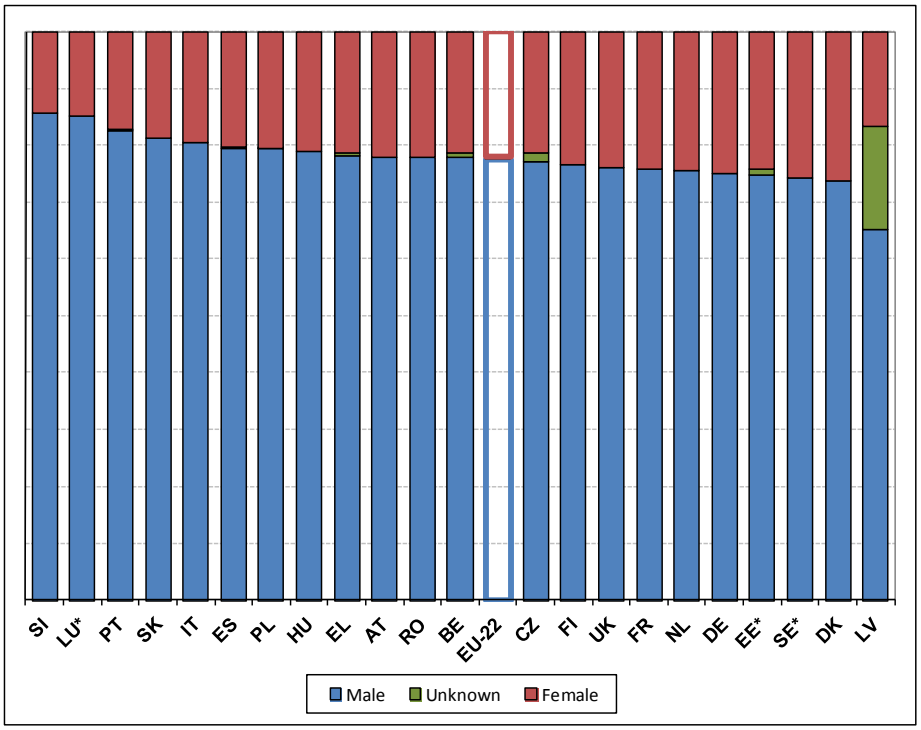

Figure 7 – Distribution of fatalities on ROU areas by gender in EU-22, 2009

Classification by person class

Figure 8 shows fatalities in accidents on ROU areas by person class in the 22 EU countries. More than 9% of the fatalities were pedestrians in 2009, a percentage that varies between countries, being highest in Latvia (28%), Estonia (21%) and Poland (21%). In contrast, 90% of the fatalities in Luxembourg, 82% in the Netherlands and 81% in Belgium are drivers, higher than the EU-22 average of 69%.In Romania 37% of the fatalities in accidents on ROU areas are passengers.

Figure 8 – Fatalities per million inhabitants on ROU areas by country in 2009

DISCUSSION

More than 225.000 people were killed in traffic accidents on roads outside urban areas in 17 European Union countries between 2000 and 2009. This number represents 55% of all traffic accident fatalities in those countries. The objective of this research is the analysis of road safety related characteristics of road accidents outside urban areas in European countries through the use of the EU CARE database with disaggregated data on road accidents.
During this research, the number of fatalities on roads outside urban areas is compared to the total number of road accident fatalities and are correlated with various road safety parameters. Latvia, followed by Estonia, has the highest fatality rate per million inhabitants on roads outside urban areas in EU-22 countries in 2009. Regarding transport mode, 23% of EU-22 fatalities on ROU areas were riders of two-wheeler vehicles (motorcycle, moped or pedal cycle users) while 60% were cars or taxi occupants. Furthermore, in 2009, more than half of the people killed on roads outside urban areas were aged 25-59. The greatest increase of fatalities on roads outside urban areas between 2000 and 2009 was in Romania (122%). On the other hand, the greatest reduction was in Portugal (64%) and Luxembourg (57%).

The results of the analysis allow for an overall assessment of accidents outside urban areas, 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 problem of road safety on ROU. Of particular interest are exposure data (i.e. length of ROU, traffic volumes, veh-kms and person-kms). Furthermore, the macroscopic analysis presented in this paper could in the future be combined with in-depth analysis of accident data by road network, thus providing better insight into the causes and impacts of accidents outside urban areas.

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